The Journal

OF THE

Ministry of Agriculture

VOL. XXIX.

APRIL, 1922, TO MARCH, 1923.

LONDON:
PRINTED UNDER THE AUTHORITY OF HIS MAJESTY'S STATIONERY OFFICE
AND PUBLISHED BY THE MINISTRY OF AGRICULTURE AND FISHERIES.
WHITEHALL PLACE, LONDON, S.W.1.

SUPPLEMENTS TO THE JOURNAL OF THE MINISTRY OF AGRICULTURE.

* Out of print.

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THE JOURNAL OF THE MINISTRY OF AGRICULTURE

Vol. XXIX. No. 1.

APRIL, 1922.

NOTES FOR THE MONTH.

Expenditure on Agricultural Education and Improvement of Live Stock.

IN a speech at Wells on 3rd March Lt.-Col. Rt. Hon. Sir Arthur G. Boscawen (Minister of Agriculture and Fisheries) referred to the recommendations of the Geddes Committee with regard to the annual expenditure of the Ministry. Before the appointment of the Committee, he said, the Ministry made a cut of £1,161,000 and the Committee proposed a further reduction of £285,171. The Cabinet had agreed, however, to a reduction of £215,000 in place of the £285,171, the chief differences being the following:—The Committee had suggested the discontinuance of the live stock schemes, and especially milk recording, but in Sir A. G. Boscawen's opinion milk recording was one of the best things that the Ministry did, and had splendid results. He was glad to say that he had been able to save it, and also the rest of the live stock schemes, except the heavy horse-breeding scheme.

With regard to agricultural education and research, he said it would be remembered that at the time of the repeal of the Corn Production Acts, an extra million pounds had been given for education and research as part of the arrangement made with the National Farmers' Union, and it was understood that this was in addition to what was being spent on these objects before. The Geddes Committee, while leaving the million (which is a single sum, not annual expenditure) had suggested a big reduction on the previous sum, but this would amount to the breach of a definite undertaking. The Cabinet had decided that the agreement with the farmers must stand, and the million would be retained in addition to what was being spent before.

Of this million, £850,000 had been allocated to England and Wales, and a scheme for the application of this sum for the de-

(42387) P.14/35. 11,250. 4/22. M. & S. A

velopment of agriculture is now being drawn up by the Ministry. The normal expenditure, which is to be continued, amounts to £397,000 per annum and provides for agricultural research and experiments; higher education at agricultural colleges and institutions; educational work carried on by county councils, including farm institutes, classes, lectures, etc.; advice for farmers and investigation of local problems; experiments with agricultural machinery; research scholarships; and improvement of live stock by means of grants to assist in the provision of good breeding stock, and for milk-recording societies.

* * * * * *

Young Farmers' Clubs.

A CONFERENCE of Members of the Young Farmers' Clubs, arranged under the auspices of the Garden Cities and Town Planning Association, was held at the *Daily Mail* Ideal Home Exhibition at Olympia on 7th March, and was presided over by the Minister of Agriculture, Lt.-Col. Rt. Hon. Sir Arthur G. Boscawen.

In his opening speech the Minister said that the Young Farmers' Club movement, which had originated in Canada and America, had now taken root in this country, mainly owing to the energetic efforts for its establishment by the *Daily Mail.* The Ministry of Agriculture was interested in this movement, and had promised to help the Members of the Clubs with such technical advice as was possible. The Minister suggested that the farming industry, which was passing through a stage of severe depression, could again become prosperous by the application of new and scientific methods to practical farming. By this movement it would be possible to influence the young people of this country to take an interest in agriculture, and to teach them the highest forms of intensive cultivation. The young members of these clubs would be trained to be practical and scientific farmers, and thus, in time, the whole industry would be placed on a better footing. Perhaps not all the members of the clubs would be able hereafter to engage in agriculture as a pursuit for their living, but it was to their own and the country's advantage for all to be interested in and to know something about the food producing industry of Great Britain. There was no doubt also that all members of the clubs could add to their income by keeping rabbits, calves, pigs, poultry or bees, or by growing fruit, flowers and vegetables, and in doing so each member would be adding something to the food production of the country.

The movement was new to this country—it was started only some twelve months ago—but the success which had been achieved in Canada and the United States of America showed that there was scope for a great extension of the movement in these Islands.

Mr. Bussy, a Director of the *Daily Mail*, announced at the Conference that an International Federation had now been formed to promote and encourage the formation of Young Farmers' Clubs in every country in the world; to act as a bureau of information; and to arrange for the interchange of live stock and seeds between members in different countries.

* * * * * *

Beneficial Insects.

IN view of the enormous damage to farm and garden crops which is attributable to the depredations of insect pests, attention has been increasingly given in recent years to a study of their life history and habits, with the object of enabling growers to exercise some definite and reasonable control over them and to ensure better and cleaner crops. It is of interest to recall, however, that not all insects are harmful, not all attack our crops and stock, but as has been shown in this *Journal* from time to time,* some are distinctly beneficial and of great value to man. So important is this aspect of insect life, and so desirable is it that these useful creatures should be recognised, that the Ministry has prepared a small booklet which is about to be issued, dealing with insects which are beneficial to agriculture.† Two capital coloured plates, finely reproduced, have been prepared to illustrate the booklet, which should prove of great value and interest to farmers and horticulturists, teachers, students and all persons interested in gardening, while it should be of considerable use in schools for purposes of nature study.

It has not been possible in the scope of the publication to consider more than certain large groups of insects, various members of which attack and destroy the worst insect pests to agriculture and horticulture. Of these groups, five are outstanding as being of great assistance to the farmer, gardener and fruit grower; they are Ladybirds, Lacewing Flies, Hover Flies, Ichneumon Flies and Tachinid Flies. Only too frequently these insects are mistaken for enemies to crops and are

* Vol. V, December, 1898, p. 326. Vol. XII, January, 1916, p. 623.

† Miscellaneous Publication No. 37, to be obtained from the Ministry, 10, Whitehall Place, London, S.W.1, price 4d., post free.

destroyed. It is hoped that the brief descriptions of them and of their life histories, together with the excellent coloured plates, may help towards their wider recognition and protection.

* * * * * *

The Agricultural Index Number.

THE average of the market prices of all descriptions of agricultural produce during February showed a slight rise as compared with the previous month, this being the first break that has occurred in the downward movement of prices since August, 1921. Prices in February were on the whole 83 per cent. in advance of the average of the three years 1911-13, as against an increase of 77 per cent. in January.

The following table shows the percentage increase during each month from 1919 to the present time:—

Month.	1919.	1920.	1921.	1922.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
January	148	... 213	... 186	... 77
February	150	... 205	... 172	... 83
March	150	... 199	... 158	... —
April	153	... 199	... 141	... —
May	132	... 169	... 112	... —
June	128	... 164	... 102	... —
July	141	... 174	... 100	... —
August	138	... 177	... 116	... —
September... ...	148	... 181	... 105	... —
October	166	... 191	... 90	... —
November... ...	182	... 197	... 84	... —
December... ...	207	... 194	.. 82	... —

Owing to the changes since 1911-13 in the varieties of potatoes principally grown, it has been necessary to revise the basis of the calculations for this description of produce, and to base figures on the most representative varieties. It will be observed that the alteration to the general index number is only 2 points.

Practically all commodities shared in the upward movement experienced during February, the chief exceptions being barley, which was practically unchanged, milk and butter, which fell 8 points and 7 points respectively, and hay, which declined a further 3 points. The greatest increase was in the case of fat sheep, which rose from 60 per cent. above the prewar level in January to 83 per cent. in February. During February fat cattle were about 65 per cent. and pigs 80 per cent. above the prices in 1911-13.

Prices of cereals showed a somewhat smaller increase compared with pre-war days, wheat being about 45 per cent.,

barley 51 per cent. and oats 47 per cent. above the average for 1911-13. Feeding stuffs on the whole were also rather dearer in February than in January. Milling offals and cotton cakes were cheaper, but the decline in these feeding stuffs was more than counterbalanced by the increased prices of linseed cakes, maize and maize meal and brewers' grains. The average declared value of imported barley during February was about £9 14s. per ton as compared with £10 8s. in January, while oats averaged about £9 6s. per ton.

The reduction in fertiliser prices was continued during the month, basic slag being considerably cheaper than in January while nitrate of soda and superphosphate also showed slight reductions. Sulphate of ammonia for February delivery was 10s. per ton dearer than for delivery during the previous month.

* * * * * *

Agricultural Shows and the Entertainments Duty.

THE Ministry frequently receives communications relative to the exemption of agricultural shows from entertainments duty. It may be pointed out that exemption from this duty rests, not with the Ministry of Agriculture, but with the Commissioners of Customs and Excise. The legal position and the proper method of applying for a grant of exemption are explained below.

All such Shows are "entertainments" within the meaning of the Finance "New Duties" Act, 1916, and therefore Entertainments Duty must be paid unless the Commissioners of Customs and Excise have granted a Certificate of Exemption.

The conditions of exemption are contained in Section 7 of the Finance Act, 1921, and are as follows, viz.:—

(a) That the entertainment is provided by a society (including a company, institution or other association of persons by whatever name called) which is established solely for the purpose of promoting the interests of the industry of agriculture (including horticulture and the breeding of animals of any description) and which is not conducted for profit.

(b) That the entertainment consists solely of an exhibition of the products of the industry of agriculture (incuding horticulture and the breeding of animals of any description), or materials, machinery, appliances or food stuffs used in the production of those products.

If any extraneous attraction, such as a band, sports, fireworks, etc., is included in the proceedings, the Show does not satisfy condition (*b*).

Where it is desired, to claim exemption, an application must be made to the Commissioners of Customs and Excise, Custom House, London, E.C.3., not less than 14 days before the Show, accompanied by copies of the Rules and last Balance Sheet of the Society and Programme of the Show. If a certificate of exemption is not received before the show, entertainments duty must be paid.

* * * * * *

Hedge and Stump Clearing.

SINCE the widespread adoption of tractor cultivation the problem of uprooting tree stumps and removing hedges has become one of considerable importance. Representative methods of doing this work were therefore tested by the Ministry of Agriculture in the early part of 1921, and the results systematically recorded and tabulated. A report* on the trials prepared by the Research Branch of the Ministry was published recently. The results have all been worked out on a cost basis and, throughout, the economic standpoint has been primarily considered. While tractor cultivation has been principally kept in view, the information contained in the report should be of value to those engaged in clearing land for gravel digging and other purposes, or in removing trees for landscape and market gardening.

Included in the test were hand tools, timber jacks, the De Jersey stump extractor (a machine from Finland operated by hand), the Hercules Triple Puller (an American machine on the windlass principle operated by horses), a ploughing engine, and steam and motor tractors, as well as explosives. Details of the tests and figures of cost are given in the publication referred to, and a summary of the conclusions arrived at is as follows:—

Where only a short length of hedge or a few stumps are to be extracted, there appears to be no advantage in going beyond the existing resources of the farm, especially if the work is done in a slack period of the year when it is a question of finding work for the men retained. Hand tools will suffice, but a tractor fitted with a winding drum will be useful, particularly in dealing with light stumps, which it should be able to remove without grubbing.

* Miscellaneous Publication, No. 35, 53 pp., 1 map and 13 figures. Price 2s. 6d. net, post free, from the Ministry, 10, Whitehall Place, London, S.W.1.

Where any considerable amount of work is involved hand-methods would prove too expensive and protracted, and a mechanical device or explosives should be used. The advantages of explosives are low cost, clean extraction and shattering of the timber, and unlimited capacity. Their use is, however, restricted by the proximity of buildings, roads, and railways, and there must always be a certain amount of danger to the operator. This last, however, can be almost entirely eliminated by proper precautions. There can be no doubt that for operations upon a large scale, explosives provide the most rapid and economical means of removing stumps.

If time is not an important factor, and the plan is to clear a large area gradually, mechanical appliances will compete in efficiency and economy with explosives. Where heavy timber is present, machines of the types of the De Jersey and Hercules should prove suitable, although neither type is likely to remove light hedge growth economically as compared with a tractor (steam or motor) provided with a winding drum. The necessity for anchoring, the restricted capacity of the grab attachments in dealing with a number of small stumps, the amount of winding necessary, whatever the resistance offered, are all factors, which by increasing cost in proportion to the volume of timber lifted limit the economic use of the former types of machine. The choice of methods is therefore largely dependent upon the relative proportions of light, medium, and heavy timber. Where all is light, the tractor may be recommended; where all is heavy, a machine of the De Jersey or Hercules type; where there is a mixture, it is a matter for the judgment of the person undertaking the work.

Without capital, it is impossible to clear any large area of land quickly, and in most instances economy and convenience dictate that the work of clearing should be restricted to a few chains a year. Where more than this is attempted, it is necessary to weigh up very carefully the cost and the increased revenue that will be obtained. This is a problem that can only be decided in each individual case.

The full report should be read by anyone who contemplates a substantial amount of hedge clearing or stump extracting. Methods are explained in detail and costs worked out minutely. With this information before him, it should be possible for the reader to determine the most economical method to be adopted in any given circumstances.

• This report is the first of a series which the Ministry proposes to publish on specific agricultural operations. A report on

drainage machinery, based upon extensive tests, is already at an advanced stage.

* * * * * *

Payment of Claims under the Corn Production Acts.

THE Ministry has now completed the work of paying out the sums due under the Corn Prices Guarantee. The bulk of the payments were made on 1st January last. In all some 188,000 separate payments have been made, totalling approximately £14,000,000.

The Ministry desires to make it known to occupiers of land who have received Orders of Payment on H.M. Paymaster General in this connection, that such orders are liable to be cancelled if not presented for payment within a reasonable time after issue. Any farmer who has not yet cashed his order therefore should do so at once. The orders must be presented for payment through a bank.

* * * * * *

Meeting of the International Agricultural Institute.

THE sixth Session of the General Assembly of the International Agricultural Institute will open in Rome on 8th May next, and the Minister of Agriculture and Fisheries has appointed the following delegates to attend on behalf of this country:—Sir Thomas H. Elliott, Bart., K.C.B. (British Delegate on the Permanent Committee of the Institute), Sir Francis Floud, K.C.B. (Permanent Secretary of the Ministry) and Mr. R. J. Thompson (an Assistant Secretary of the Ministry).

The programme to be dealt with by the Assembly is extensive, including the consideration of a number of reports on the organisation of the Institute and the work carried out by its various branches, and also reports on such subjects as the increase of agricultural production, agricultural meteorology, agricultural book-keeping, and a proposal for the establishment of an International Institute for Research into Plant Diseases.

In addition, the United States Government will submit a number of proposals for action by the Institute with the object of improving the collection and publication of agricultural statistics in the adhering countries. Though the work which the Institute endeavours to do in connection with agricultural statistics may seldom come directly to the notice of farmers, nevertheless the publication of full and prompt information

as to crop prospects, harvests, and numbers of live stock in all the countries of the world is of considerable importance to them, as prices in this country are dependent upon world prices, which are greatly influenced by such reports.

* * * * * *

Thoroughbred Stallion Show.

THE Annual Show of Thoroughbred Stallions arranged by the Ministry in conjunction with the Hunters' Improvement and National Light Horse Breeding Society, was held at the Royal Agricultural Hall, Islington, from 28th February to 2nd March. The principal purpose of the show is the selection of stallions for the King's Premiums which are awarded by the Ministry under its scheme for the encouragement of Light Horse Breeding. The premium stallions are required to serve mares at low fees, which are prescribed by the Ministry. The routes to be travelled by the premium stallions are arranged at the close of the show.

This year 88 stallions were entered, as compared with 97 last year, and 57 King's Premiums, including 12 Super Premiums, were awarded. The King's Champion Challenge Cup for the best Premium Stallion was awarded to "*Gay Lally*," the property of the Compton Stud, the reserve horse being "*Scarlet Rambler*," belonging to Captain T. L. Wickham-Boynton and Mr. H. A. Cholmondeley. These two horses obtained the same distinctions last year and in 1920. The principal winners were the Compton Stud, who obtained four Super Premiums (including the King's Cup) and three King's Premiums.

Arrangements are being made for the award of a limited number of Ministry's Premiums to Stallions which will travel approved routes.

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Conciliation Committees in Agriculture.

THE Conciliation Committees continue to work satisfactorily, and there are now 42 agreements of which 24 are for periods including the corn harvest. A gratifying feature of the past month is the fact that agreements have now been reached in several areas where negotiations between the two sides had been somewhat protracted, notably in Norfolk, Suffolk, Lincolnshire, West Riding, Bedfordshire, Huntingdonshire and Oxfordshire. Details of the current agreements appear on pp. 93-96.

A RECORD OF 12 YEARS' DEVELOPMENT ON A 1500 ACRE FARM.

WILFRID S. MANSFIELD and D. BOYES.

THE Shippea Hill Estate of Messrs. Chivers and Sons is situated 7 miles from Ely, at the junction of the Cambridge, Norfolk and Suffolk borders. It lies in the fen country, and has on the north the Little Ouse (or Brandon River) and on the east the Lakenheath Lode, while on the west it touches the main road from Littleport to Mildenhall. The Great Eastern Railway Company's line to Norwich runs through the centre of the estate, and the railway station of Shippea Hill is on its western edge.

Like most of the fen country, the district is very thinly populated, and though there is a railway station there is no village of Shippea Hill. The parish is large and extends as far as Lakenheath, a distance of 3½ miles.

The estate lies in two drainage areas, Burnt Fen and Sedge Fen, and it was after the first of these that the railway station was originally named. At the request of the local farmers, who feared the effects of the prejudice against potatoes grown on fen soil, the name was, however, changed; the justification for this procedure being the fact that the soil on the estate is not black fen soil at all, and that potatoes grown on it are of good quality. Indeed, the " once grown " seed it produces is eagerly sought after by the neighbouring black land farmers.

As is usual with land in the fen districts, the estate lies at a lower level than the river which drains it, and all drainage water has therefore to be lifted by pumps. As might be expected, the water table is high, and a system of open drainage by means of ditches (" dykes ") is necessary. Naturally the expense of such a drainage system is heavy, but, on the other hand, there are certain advantages, one of these being that the height of the water table can, to some extent, be controlled. In a season such as that of 1921 this ability to keep up the water table has been of great value; particularly was this demonstrated last season in the case of one field of strawberries which yielded at the rate of 3 tons 17 cwt. per acre, a fact that emphasises once more the value of irrigation for this crop in a dry season.

The estate is about 3 miles long and, at its centre, about 2 miles wide. It is contained in a ring fence, and its area is about 1,570 acres, of which 102 acres are " washes " (land bordering on a river and liable to flooding) and 226 acres grass land.

The soil is of a very unusual character, consisting of from 2 to 6 feet of "shell marl" overlying 7 to 10 feet of peat, beneath which lie sand and gravel. This layer of shell marl is known locally as "White Land," and forms a soil which is easy to work, though in places too open and spongy. It is also deficient in humus, and some years ago an attempt was made to remedy this defect by the application of large dressings of peat. The experiment was a failure. Not only was no benefit derived from the dressings, but actual harm was done to the soil, which, after the lapse of several years, has not yet fully recovered.

Wheat, oats, mangolds, potatoes and green vegetables are the crops naturally suited to the soil. The grass land provides an abundance of keep, and, though this is not of the highest quality, it is excellent for milk production.

Condition of the Estate before 1909.—Before its purchase by Messrs. Chivers the land was in the hands of many owners. There were three farms, of some 300 acres each, two of which were owned and farmed by one individual. In addition, there were two smaller holdings of 155 and 119 acres respectively, the larger of the two having no buildings on it at all. The remainder of the land was cut up into small detached portions which were in the hands of different owners and were farmed "off-hand."

For the most part the land was in a very low state of cultivation; fields were choked with couch and other rubbish, and were poverty-stricken to a degree. Yields were poor and the general level of farming was extremely low. In fact, it was asserted that wheat could not be grown on this soil unless there was a mass of couch and twitch growing with it! With the exception of the two farms already mentioned as being farmed by the landlord, where a higher state of cultivation prevailed, very little dung ever reached the land, and the use of artificial manures was almost unknown. The principal crops were wheat, oats, and barley, but a few potatoes and mangolds were also grown.

There were three reasons for the state of affairs which has just been described: lack of labour, lack of transport facilities, and lack of farm buildings. The first of these was due to the shortage of accommodation. On the whole of the estate there were only 13 cottages, and there was only one building which could be really described as a "house." The cottages were of wood, one storey high, and were very small. Labour, other than that resident on the estate, was difficult to procure, and had to be drawn from the village of Lakenheath, 3½ miles distant.

In 1909 this estate of 1,570 acres gave regular employment to 29 men only, or not quite 2 men per 100 acres.

Even if a plentiful supply of labour had been available it would still have been impossible for the original occupiers of the estate to grow the bulky crops for which the land is most suitable. Apart from the main road from Littleport to Mildenhall, which touches the estate on one side, there was no made road of any description; and, although the railway station was not far from any of the farms as the crow flies, yet to reach it a journey of from four to five miles over fen " droves " was necessary.

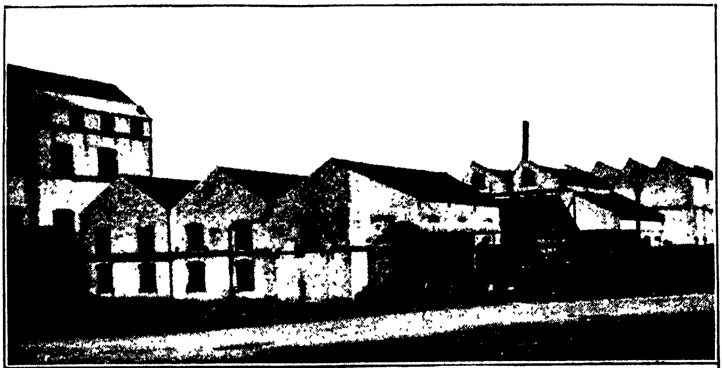
Only those who have seen a fen drove in winter can realise the significance of this assertion. It is, however, sufficient to remark that such droves rapidly become quite impassable if anything in the nature of heavy traffic is attempted.

Obviously, then, all carting had to be done in the autumn or during spells of frosty weather; and therefore it was out of the question to contemplate growing large acreages of potatoes and vegetables.

As regards the shortage of farm buildings, it is hardly necessary to remind practical men of the impossibility of farming arable land without a proper equipment of these. Successful arable farming implies the use of dung; and to have ample supplies of dung buildings are essential. In the case of the Shippea Hill estate the buildings were quite inadequate for the acreage they had to serve and, moreover, were of a very poor description, being as often as not mere ramshackle wooden sheds.

It will be easily seen from the foregoing that for the development and improvement of such an estate a large amount of capital was needed. Moreover, even if one of the farms had by chance come into the possession of an enterprising and wealthy man he would have been unable to develop the land without the co-operation of neighbours. The only possible solution of the problem was the purchase of the whole estate by some person who was able and willing to spend the large sum of money necessary for its development.

Development of the Estate.—In 1909 Messrs. Chivers purchased 900 acres of land lying in the centre of the estate. This portion included land which now forms part of Railway Lodge Farm, Adventurer's Farm, Lea Farm and Albion Farm. In order to ease the transport problem it was proposed to obtain communication with the main road by making up Farthing Drove and by running a siding from the railway line at a point opposite Railway Lodge Farm. These plans turned out to be impracticable. The work of making up Farthing Drove was begun, but it soon became apparent that the task



Above, Chicory and Herb Drying Factory.
Centre, Old Cottage.
Below, New Cottages.

would be far too great to be accomplished with the means then available. In addition, it was found that the proposed siding would necessitate the erection of a signal-box and the permanent employment of two signalmen.

A solution of these difficulties was discovered in the purchase of Station Farm. This ran right up to the main road and, moreover, adjoined Shippea Hill station. It was therefore possible to run a siding from the station to Railway Lodge Farm without having the expense of maintaining a special signal-box. This siding was constructed, and the work of developing the estate proceeded rapidly.

The next purchase was that of Decoy Farm, which lies on the opposite side of the railway line. The disused duck decoy, after which the farm was named, occupied a tract of about 17 acres, covered thickly with brushwood and small trees. The work of clearing the disused decoy was begun at once, and the faggots thus obtained were used in the construction of a road running along the new siding from the station to Railway Lodge. The foundation of this road was of faggots overlaid with clinkers, the whole being topped with a granite facing.

From the point where the full gauge siding ended a system of light railways began to radiate to the surrounding farms, no less than 9 miles of railway being laid down. Thus it became possible to continue road-making in every direction, a task which previously could not be undertaken.

The most important and urgent problem was obviously that of transport; when that had been solved the work of development could be carried out in other directions. It will be easily seen that the construction of so many roads and railways required a large amount of labour, and since further development of the estate would also involve the erection of a large number of buildings, it became necessary to have labour resident on the spot. In 1910, therefore, a dormitory with accommodation for 100 men was erected at Railway Lodge, together with mess rooms and a central kitchen. In these buildings the extra labour required for road-making, building, and work on the land was housed.

Great difficulties were encountered when the work of putting up farm buildings and cottages was begun. It will be remembered that the surface soil of the estate consists of a layer of shell marl resting on peat; the erection of any heavy building in such circumstances obviously demands great care in order to avoid subsidence. The procedure adopted in this case was to

drive in piles through the layer of peat to the gravel below, and on these piles to make a concrete platform on which the building was erected.

Hand in hand with these developments went the work of bringing the land into a profitable state of cultivation. As new buildings were erected the head of stock on the farms was increased and more dung became available. In addition, large quantities of London dung were imported, as well as hundreds of tons of artificials. Early potatoes were at first grown on a large scale, but owing to the late frosts, which are a characteristic of this part of the fen country, their culture was abandoned in favour of main crop varieties for which conditions are particularly suitable, about 1,500 tons having been produced during the season of 1921.

When the estate was first taken over in 1909 there were three orchards, 30 acres in all, one having been recently planted. This last showed such promise that it was decided to plant others, each with top and soft fruit. These have proved very successful, and fruit growing is now a feature of the estate.

Even the "washes" which are under water during the winter for weeks at a time have been utilised. Three varieties of willows are grown on them, and these supply more than enough osiers for the manufacture of all the baskets needed by Messrs. Chivers, and a large surplus is available for sale. In the season 1920-1921 nearly 150 tons of osiers were produced.

Present Condition of the Estate.—There are now nine farms on the estate, each with its own staff under a foreman, the whole nine being under the control of a resident manager whose office is in telephonic connection with each farm. Two of the farms are devoted entirely to fruit, four are fruit and arable farming combined (one of these has in addition a herd of dairy cows), two are ordinary arable farms, and one is a poultry farm.

The number of cottages has been increased from 13 to 42, and there are two houses; 300 people can be housed and fed in the present dormitories and mess rooms, and an electric laundry, a bakery and a co-operative store render this colony of workers to a large extent independent of the outside world. This independence of the estate is also emphasised in another direction by the presence of a carpenter's shop and a blacksmith's shop, where all repairs necessary to implements and buildings can be carried out.

The idea of growing chicory on the estate had been entertained from the first, and a factory for chicory roasting was one of the

first buildings to be erected. This has now been increased in size, and plants for the distillation of peppermint and the drying of herbs, such as parsley, spearmint and sage have been added to it.

Some idea of the extent of these " side-lines " will be given by the following figures. The total weight of chicory handled by the factory during the 1920-1921 season was 1,036 tons, and about 50 tons of green herbs have been dealt with.

Since 1909 the range of crops has been greatly increased. To the limited list grown by the former occupants of the estate have been added market garden crops, top and soft fruit, and herbs. There are now 212 acres under fruit, the principal crops being plums, apples, gooseberries, strawberries and raspberries. A very large acreage of potatoes is grown every year, and large quantities of cabbage, cauliflower, and celery are sent to the London markets.

During the last season some 500 tons of fruit were grown. Among the market garden crops celery and cabbages were most important, 4,507 rolls of the former and 4,725 tallies (a tally is 5 dozen) of the latter being sent away. There were also 972 tallies of cauliflowers. Wheat (1,292 qr.) and oats (1,219 qr.) were the chief cereals, and among the various " oddments " were 42 qr. of rye, 21 of mustard, 40 tons of swedes, and 200 tons of seeds hay.

Pigs and poultry are now important features of the estate. The pigs are Large Whites, some 45 sows being kept. The whole of the stock bred are fed off for bacon, their food consisting mainly of home-grown corn and chat potatoes. There is a central poultry farm, under the control of a lady manager, where incubation and rearing are carried on. The aim here is to obtain about 1,500 pullets annually, of which 500 are kept under the intensive system at the central farm, while the remaining 1,000 are distributed over the other farms (on each of which the manager has an assistant) and kept on the colony system. The breed is White Leghorn and the total number of eggs laid on the estate last year was 207,500.

Numbers of bullocks are fed annually and a pedigree herd of Lincoln Red Shorthorns is kept for milk production. In order to provide feed for these animals mangolds are grown in quantity (2,876 tons this season), and do extraordinarily well on this soil. The past season was particularly favourable for this crop, and four fields on the estate yielded over 60 tons per acre of cleaned roots, hot sunny weather combined with a high water table having much to do with this result.

The head of stock on the estate is a large one. In addition to the pigs previously mentioned there are 72 horses and usually about 200 head of cattle, but in spite of this a vast quantity of London dung has to be imported every year, this importation being necessitated by the presence of so large an acreage of strawberries and market garden crops in the scheme of cultivation.

In its present condition the estate offers a remarkable demonstration of the results that can be achieved by enterprise and organisation when these are backed by capital. To an undiscerning eye no material could have appeared less promising than this tract of country as it stood previous to 1909: water-logged and weed-ridden, without roads, isolated, and altogether poverty-stricken. The task of developing such land might well have seemed not only insuperably difficult, but hardly worth while. Yet at the present time one finds that, instead of the 29 men permanently employed on it in 1909, there are no less than 150 men and 50 women (*i.e.*, 9 men and 3 women per 100 acres), and, moreover, that at certain periods of the year, such as the fruit-picking season, 200 extra men and women are required. In addition to this, the amount of produce taken from the land annually has enormously increased.

It is hardly necessary to emphasise the value to the community of the work which has been briefly outlined in the preceding pages: the increase in the resident population of this area and the increase in its productivity are facts which have an unmistakable significance. But it is, perhaps, worth while pointing out the violent contrast between the use made of capital at Shippea Hill and its misuse in certain other parts of these islands. In the one case we see a low state of cultivation turned into a high one, and a great increase taking place in the resident population; while, in the other, we have the spectacle of a low state of cultivation becoming a state of no cultivation at all, and a population being literally driven into towns or overseas to earn its livelihood. There can be no question as to which of these courses is designed to benefit the nation.

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HOW TO PRODUCE CLEAN MILK.

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The production and handling of milk on the farm consists of a long chain of operations which differ materially in nature and in the conditions under which they are carried out. Milk production may be said to begin with the selection of the cows, and handling, in so far as the average farmer is concerned, to end with the delivery of the churn of milk at the railway platform or the wholesalers' or retailers' premises.

Attention to detail at all stages in the chain is desirable, but it must be helpful to those engaged in the work to know the *relative importance* of the different operations. It cannot yet be said that all stages in this chain have been sufficiently investigated, but it is nevertheless possible to summarise the conclusions arrived at by different workers; fortunately, these conclusions are more or less in complete agreement as to the factors which are of prime importance in the production of clean milk. These factors are as follows :—

(*a*) The animals producing the milk, and the workers at all stages, should be in good health and free from any disease which may be carried by milk.

(*b*) The utensils used should be thoroughly cleaned and sterilised.

(*c*) The cows, and particularly their udders and teats, should be thoroughly cleansed before milking.

(*d*) The milking pail should have a small opening, thus lessening the space whereby dust and dirt may fall into the milk.

(*e*) The milk should be cooled soon after milking to a temperature of 50° F. or lower, and maintained at a low temperature afterwards.

The steps which may be taken by farmers to bring these factors, and particularly the last four, into active operation on their own farms will now be considered in detail.

Health of the Cows and of Workers in Cowshed and Dairy.— The importance of guarding against milk conveying infection either from the cows or from the dairy workers has been realised for many years, and the subject has been dealt with in several Acts of Parliament and Orders made under certain Acts.

The chief of these are the Dairies, Cowsheds and Milk Shops Orders, 1885, 1886 and 1889; the Infectious Diseases Prevention Act, 1890, and certain Orders of local application, such as are in force in Liverpool and Manchester. Copies of these can be obtained from His Majesty's Stationery Office, or from the offices of different local authorities, and as the duties of the farmer or dairyman are plainly stated further reference to these Orders is unnecessary here.

On 1st September, 1922, unless Parliament otherwise determines, the Milk and Dairies (Consolidation) Act, 1915, will come into force, and thereafter this Act will be the chief legal enactment relating to the handling of milk. Copies of the above Orders and Acts should be procured and studied by all dairy farmers.

Cleanliness of Utensils.—There is a wealth of evidence to prove that one of the most frequent and fertile sources of contamination is the utensils used in the handling of milk. It is therefore of fundamental importance that they should be thoroughly washed and sterilised.

Methods of Washing.—To attain this end they should be rinsed with cold water immediately after use. It is often customary after the morning milking to leave the milking pails, cooler, etc., unwashed until after breakfast; during the interval a thin film of milk tends to dry on to the sides, especially in warm weather, and the utensils are then more difficult to cleanse. If they are rinsed with cold water immediately after use the washing will be made more easy. Hot water should not be used for the first rinsing of milk vessels, because the heat causes some of the milk to dry on the sides, and in a short time the tinned surface becomes covered with a thin layer of dried milk, which can only be removed by repeated scouring with sand or other scouring substance.

The utensils should then be thoroughly washed in hot water containing some soda or other cleansing agent, and afterwards rinsed in clean hot water. The final process is the scalding or steaming. If steam is not available the utensils should be immersed in boiling water for, say, three minutes, or in the case of utensils such as a cooler or churn, which cannot be placed in an ordinary copper, boiling water should be poured over or into them until they are too hot to be touched by the hand. If steam is available all utensils should be steamed for at least three minutes over a steam jet or in a sterilising tank. After scalding or steaming they should be inverted on a rack in a

clean place to drain and dry; they must not be dried by means of a cloth—this would tend to reintroduce germs into the newly sterilised vessels. The heat which has been imparted to the metal by the boiling water or steam should be sufficient to dry the utensils almost at once. They should remain on the rack until required for further use. Where there are ample buildings, this rack should be in a clean room, but on many farms stands or racks for dairy utensils are out of doors in the sun. This is not a drawback provided they are well protected from dust or other contamination.

The equipment required for thorough washing and sterilising of milk utensils is not expensive. On small farms there is often a copper for boiling water, and even where the supply has to be obtained from the kitchen it is still easily possible to ensure that the utensils are properly cleaned. A simple steaming outfit without a boiler has also been recently introduced* which will give excellent results at a low cost. It has been designed for small farms. On larger farms the installation of a boiler is not a very expensive item, and the steam may be used for cooking pigs' food as well as for heating water and sterilising dairy utensils.

Construction of Utensils.—Thorough cleaning will be made easier by using only well tinned utensils with the seams flushed smooth with solder and without corners and crevices. Many farmers, for the sake of economy, use galvanised iron pails for milking, but pails of this material are very much more difficult to clean and are seldom found in a satisfactory condition. It is much truer economy to have the best make of utensils and avoid loss of milk by souring. The milking and carrying pails and measures are easy to wash, and special attention should be given to corners and crevices at the seams and spouts. The cooler presents greater difficulties; it should be detached from its stand and placed in a tub, on its own feet, for washing—if allowed to rest on the edge of a tub the bottom becomes dented and uneven, and is made much more difficult to clean and dry. The weakness of the bottom is one of the greatest defects of the ordinary farm cooler, and makers might with advantage consider the strengthening of this part. The folds should be sufficiently wide to be easily cleaned, and no strainer should be included as part of the cooler; such strainers are usually of wire gauze, and are quite ineffective.

* Particulars may be obtained from the National Clean Milk Society, 3, Bedford Square, W.C.1, or from the National Institute for Research in Dairying, University College, Reading.

The receiver or pan of the cooler is easy to clean, but special attention should be given to the tap. Old-fashioned taps with a cavity above the inlet hole are very difficult to clean and should have this cavity filled up. Most new taps have no such cavity and no crevices.

Strainers and Straining.—Strainers should consist of as few pieces as possible. Those made of wire gauze only are not merely useless, but do much more harm than good.

Where cloths are used for straining, whether as part of a metal strainer or simply tied over the mouth of a cooler pan, several should be provided so that a clean one may be available for each milking. Such cloths should be of very fine mesh, and must be most carefully washed and boiled, following the method already described for utensils. Strainers containing a layer of cotton wool are also very effective, particularly those where the milk falls on a metal plate first, instead of directly on to the straining material. The latter does not have to bear the weight of the falling milk, hence there is less chance of the particles of dirt being forced through the strainer. The amount of brownish sediment retained by the strainer is a good indication of the degree of cleanliness of the cows, and of the care taken in milking; in fact, the strainer has a greater value for this purpose than for any other; the passing of milk through a strainer may take out small pieces of straw and hairs, but the soluble matter and the numerous germs are simply washed through and even more completely distributed throughout the milk than was the case before straining. On the modern dairy farm the true use of a cloth or cotton wool strainer is to enable the milker to detect evidence of udder trouble before it could be found by handling the udder or the act of milking.

Churns.—The churns used for the conveyance of milk from the farm are often a fertile source of contamination, but in this case the purchaser of the milk often has a greater share of the responsibility than the farmer. Many large firms supply churns and undertake to send them to the farmer in a clean condition. If they should arrive at the farm in an unsatisfactory condition it is scarcely to be expected that the farmer will cleanse them as they ought to be cleansed. He may not have the time, labour or equipment required to cleanse and sterilise the large 17-gallon churn in common use. There is an overwhelming case in favour of the use of a smaller churn, in so far as ease of cleansing and handling are concerned. When churns arrive at the farm in an unclean condition they should be washed and scalded or steamed

in the manner already described, so far as time and equipment permit.

Farmers who are also retailers of milk have the additional responsibility of ensuring the cleanliness of the cans or bottles used in distribution. The method of washing previously described is likewise applicable here, and care should be taken in the purchase of delivery cans and churns to see that their internal construction as to seams, angles and taps is such as to make thorough washing as easy as possible.

Milking Machines.—Where milking machines are used the question of thorough cleansing is of even greater importance than where only hand milking is practised. All parts of the machine which come in contact with the milk must be thoroughly cleansed at least once daily, and the time required for this work necessarily varies according to the construction of the machine. Those with simply-made teat-cups, the minimum amount of rubber or celluloid tubing, the fewest joints, and with milk receivers without crevices and easily washed by hand, will be most advantageous in this respect, whatever may be their merits or demerits in others.

The mode of washing recommended by successful operators and careful students of this subject is as follows: Immediately after milking clean cold water should be drawn through the teat-cups, milk tubes and receivers, and all parts thoroughly rinsed. They should next be taken to pieces and washed in hot water containing soda or washing powder, the teat-cups, claws and tubes being well brushed inside and out. The teat-cups and tubes should then be fitted together and clean hot water drawn through followed by scalding water or steam. They may then be hung up to drain and dry and left thus until next milking. Another effective method of treatment is to immerse the cups and tubes between milkings in clean cold water containing a disinfectant—lime water, brine, and a mixture of brine and lime water have been found most satisfactory in America. When the teat-cups and tubes have been properly washed and steamed after the morning milking, it is sufficient to rinse them thoroughly with cold water in the evening. It is also necessary to guard against contamination of the milk by entrance of water from the vacuum pipes or oil from the pulsator, and to see that badly worn rubber parts are renewed when necessary.

Cleanliness of Cows.—In the cleansing of the cows, attention must be given to the hind quarters, flanks, udder, teats and the part of the belly immediately in front of the udder. When the

cows are at pasture day and night it is easy to keep these parts clean but when they are in the cowshed during the night it may be very difficult indeed. Much depends on the construction of the floor of the stall. Where the cowshed has single or double stalls of such a length that the manure falls into a fairly deep gutter, or where some other method is adopted to prevent the cow fouling the rear part of the stall, the cows will be much cleaner than where the cowshed has neither stall partitions (travises), raised standings nor gutters. On the other hand, if the removal of the manure be attended to frequently, ample litter provided and the cows groomed daily or before each milking if necessary, exceptionally clean milk can be produced in a very badly constructed cowshed.

The cleaning of the hind quarters, flanks, etc., will be made much easier if these parts are clipped by means of horse clippers when the cows begin to lie in overnight. The udder may also be clipped, but the objection is often raised that this will lead to cold in the udder, bad quarters and other troubles. In several herds well known to the writer, the udders have been clipped every winter for from two to eight years and there have been no bad results. In any case, the long locks of hair often found on the udders of newly calved cows should be removed when milking is recommenced. These long locks often get very dirty and, when included in the hands in the grasping of the teats, cause contamination of the milk and kicking or restlessness on the part of the cow.

Immediately preceding milking, the flanks, if dirty, should be washed clean by means of a brush and water; the udder and teats should always be washed and, when necessary, the loose moisture dried off afterwards by a clean cloth. Clean water should be obtained from time to time as required. It is most important that the sole of the udder and adjacent parts should be made clean, because it is from these parts that hairs, dust and dirt fall downwards into the milking pail. The writer has often found cows which appeared to have been thoroughly cleaned, yet close examination showed that the slight hollows between the teats and sometimes the left flanks and sides of the udder were dirty. It is not sufficient occasionally to wipe the udder and teats with a moist cloth when sitting down to milk; this may at first moisten the hair of the udder and prevent the loosening of particles of dust, but the udder soon becomes filled with hot milk, both skin and hair are quickly dried, and when the udder is shaken during the process of stripping, loose

hairs and dust are detached and fall on the top of the milk. Observant milkers have often noticed that a pailful of milk which appeared clean has, after stripping, received a thin covering of brownish particles. The cleaning previous to milking should be so thorough that this cannot happen.

Milking.—After cleaning the cows, the milkers should wash their hands and proceed to milk. If overalls are provided for wearing during milking, so much the better, but they are not essential. A pail or basin of water, with soap and towel, should be provided at a convenient place, so that the milkers may wash their hands before commencing to milk each cow. The opening at the end of the teat may contain particles of dirt and a considerable number of germs, hence it is desirable that the first two or three streams of milk from each teat should be drawn on to the floor of the stall or gutter or into a small pail used only for this purpose. If drawn on to the floor of the stall, this milk should be washed away after milking so that the litter or floor of the stall may be sweet and clean—otherwise harmful germs may grow and ultimately find their way into the teats and thence to the udder when the cow lies down. Where the rear part of the stall has a porous floor which cannot be properly washed, it is advisable always to collect the first few streams into a pail; this milk may be used for calves and pigs. When a large herd of cows has to be cleaned and milked, it may be found most economical in labour to make one boy or man responsible for all the washing and drawing of the fore milk.

It is necessary here to discuss briefly the question of wet or dry milking. The custom, so prevalent in the South of England, of moistening the hands with milk occasionally to make teats and hands more pliable, is always objectionable, especially so when the teats and udders have not been cleaned. At the same time, it must be recognised that where one or more of the teats are small or do not deliver the milk in an even stream, it is well-nigh impossible to prevent some milk getting on to the hands; also, milkers who at other times are engaged in hard manual labour undoubtedly feel the need of some lubricant to make the hands more flexible for the operation of milking. This need is still greater in the case of cows which have thick-skinned teats or are hard to milk for other reasons.

Much of the criticism of dry-hand milking comes from those who have never tried this method in conjunction with systematic washing of the udder and teats. Where the method of cleaning described above is practised, it will be found that both milkers'

hands and cows' teats become more flexible, and wet-milking with milk as the lubricant becomes unnecessary and is soon recognised as a dirty habit. When a cow has sore teats, it is permissible to use vaseline during milking, but in such cases great care must be taken that the milk never touches the hands. In severe cases the milk thus obtained should not be mixed with that offered for sale.

From personal experience the writer has found that the adoption of dry milking, combined with careful cleaning, has resulted in the skin of the teats becoming of a soft yet tough texture, with a greater freedom from sores, and the whole operation of milking has become much more easy and pleasant.

Attention should also be paid to the cleanliness of the milking stools, especially the upper parts of the legs. Where the hands are allowed to become wet with milk, this part of the leg, unless regularly washed, gradually acquires a layer of dried milk. This accumulation is not merely an evidence of carelessness and dirty habits; it is also a ready means of carrying infection from a cow with a bad teat or quarter to another cow, because the leg of the stool is the first thing touched on rising from a cow, and the last thing touched on sitting down to milk again. A dirty stool leg may easily nullify all washing of the hands between the milking of individual cows.

Milking Pails with small Openings.—The common type of milking pail is widest at the mouth, so that it may be easy to milk into, but this advantage has the corresponding disadvantage that all the pieces of litter, hairs and dust which fall from the udder cannot but drop into the milk. Numerous types of pails have been designed to lessen this defect, and the use of the best of them has been found to lessen considerably the amount of dirt and germs gaining entrance to the milk. Some types have the opening so reduced in size that milking becomes much more a matter of good aim than usual, and such pails also require more careful washing than ordinary pails. If properly washed and sterilised, however, they are of great assistance in the production of clean milk, particularly so where the cleaning of the cows has not been very carefully done. When the udders and adjacent parts are washed clean, there is not the same advantage to be gained from the use of such pails. It is worthy of note that those who have used pails of this type find that the slightly increased loss of milk at milking times from part of streams of milk failing to enter the pail is balanced by the reduced loss when a fractious cow or heifer upsets the pail. Because of the

small opening, little or none of the milk is spilt on these occasions.

When a milking machine of the suction type is used, all the advantages accruing from the use of a milking pail with a small opening are obtained. The amount of visible dirt gaining entrance to the milk is undoubtedly lessened in cases of mechanical milking, at least so far as the milk drawn by the machine is concerned, but the germ content may be increased and the keeping quality and flavour of the milk depreciated if the parts with which the milk comes in contact are not kept scrupulously clean. Where stripping is done by hand after the removal of the machine, it is desirable that all the precautions already described should be taken as to cleanliness of udder and teats. otherwise the strippings will contain exceptionally large amounts of dust, hair and dirt and increase the germ content of the milk while at the same time raising the percentage of butter fat.

Cooling of the Milk.—Where milk is sold for direct use as a food, it should be cooled at the farm as soon as possible after milking. The use of coolers on farms has become increasingly common in recent years, and in spite of the additional risk of contamination by the passing of the milk through and over the different parts of the cooler, there is no doubt that effective cooling greatly lessens the loss of milk by souring and prevents the growth of the germs which may have gained entrance to the milk. Effective cooling, however, depends primarily on a supply of cold water, and there are many farms which are very badly off in this respect. They may be in a district where the supply is limited in extent and the use of a cooler is impossible. Under these circumstances something may be accomplished by placing the pails of warm milk in a trough of water. Where the water can be kept running through the trough good results may be obtained, but where the trough has to be filled from a pond or well it is doubtful if the results obtained warrant the expenditure of the necessary labour. These conditions are most often found on small farms and may be aggravated by the existing supply being badly contaminated, especially in summer, thus making it more difficult to clean the utensils. The production of wholesome and good keeping milk on such farms is a difficult matter. and probably the best that can be done is to keep the cows clean. wash the milking pails carefully, and have the milk as soon as possible after milking collected and transported to a depot where it can be cooled to a low temperature by means of a brine plant. The cleaning of the churns in which the milk is transported

should be carried out at the depot and they should be returned to the farm in a clean, dry condition.

On large farms the difficulty of water for cooling has often been overcome by the introduction of a supply from a county or district main or by pumping from a well to a storage tank located in the roof of the milk cooling room or adjacent building. Under these conditions the problem is merely one of making the best use of available supply. Every farmer who cools milk should have a thermometer in use to find out the temperature to which the milk is cooled. With a fair volume of water and sufficient time it is easily possible to cool the milk to within two degrees of the temperature of the water entering the cooler; *e.g.*, with water at 58° F. the milk should be cooled to 60° F.

When the cowshed and milk cooling room are situated near each other, the best results will be obtained by each milker carrying the milk from each cow in turn to the cooler; this gives ample time for efficient cooling. When the situation is not so convenient, the milk may be collected in carrying pails and conveyed to the cooler from time to time. These carrying pails usually stand in the cowshed and should be provided with lids to prevent dust and splashes of manure falling into the milk. On many farms it has been found of great assistance to have a milk receiving pan fitted up on the other side of the wall from the cooler, and a short wide pipe leading through the wall and emptying into the pan of the cooler. By this device much carrying of milk may be saved and the risk of contamination by dust when each milker enters the cooling room with milk is very greatly lessened. Where the milkers must pass in front of the cooler to empty milk into the pan, or where there is the risk of dust blowing on to the falling stream of milk, a sheet of tin (tinned sheet iron) may be hung in front of the cooler as a protection.

After the milk has been cooled the churns should be closed and kept in a cool clean place until despatched from the farm. Where the milk leaves the farm once daily, special care must be given to the storage of that milk which has to be kept for the day or night; in this case the mouths of the churns should be covered by the lids or by clean cloths.

Relative Importance of Methods and Equipment.—In the preceding pages special emphasis has been laid on the *methods* which should be adopted in the production of clean milk and comparatively little has been said about the equipment. The reasons for this concentration on how the work should be done

rather than on the provision of buildings and apparatus are two in number. Firstly, the amount of actual "hand work" in milk production and management is very great, hence almost everything depends on the individuals doing the work. If the person doing the work is taught the *best way* and *does it*, a very great improvement can be brought about with little or no expenditure. Secondly, the cost of improving existing buildings or erecting new cowsheds and dairies is sure to be heavy, and if the production of clean milk were primarily a matter of new buildings and high expenditure, little or nothing would be done for many years.

It is desirable, however, to study this question from different points of view and to maintain a due sense of proportion. It is quite correct to say that clean milk of the highest standard can be produced under very primitive conditions, provided attention is given to the cleanliness of the utensils, the cow and the milker, but it may not be a practical proposition to attempt to maintain such a standard of cleanliness, day after day, summer and winter, without taking steps to improve the cowshed or the water supply and thus lessen the expenditure of time and labour. The point of view of the cowman or milkers must also be appreciated; if nothing is done by the master to prevent cows wading in filthy mud or lying down amongst manure, one must not be surprised if exhortations to greater cleanliness meet with little response from the men. On the other hand, through carelessness or ignorance as to proper methods an ideal cowshed and dairy with a complete plant may turn out milk which soon goes sour.

The variation in the construction and internal arrangement of cowsheds in this country is extreme—some are so bad that no description can be attempted, and others are very good indeed—and, in this article, it is unnecessary to attempt to lay down any general rules beyond stating that there should be good light and ventilation, and stalls and floors so constructed that they will assist in keeping the cows clean. Regulations as to ventilation, airspace and superficial area have little to do with clean milk production apart from their bearing on the health of the cows.

With regard to the milk room, in the past too little attention has been given to its situation and construction. Broadly speaking, each farm from which milk is sold should have a clean cool room in which the cooling is done, the full churns stored until despatched and the clean utensils and churns kept after washing until again required. The washing of the utensils should be done in another place—a lean-to open shed would do for this

purpose so long as they were properly washed and kept free from contamination.

One point in the equipment of a farm for milk production is supremely important, namely, the water supply for cooling and cleansing purposes. Where this is defective the tenant farmer can hardly be held responsible. Suggestions have been made in the preceding pages as to the means likely to give the best results, but it should be clearly recognised that in some districts the lack of an ample supply of water constitutes a handicap in clean milk production which can only be overcome by considerable capital expenditure and fair arrangement between landlords, tenants and any others interested.

The relative importance of equipment and methods must therefore vary from farm to farm according to local conditions, and each farmer should study the problem as it presents itself on his own farm. On general grounds it is interesting to note that in the Inspection Report Card for Dairy Farms issued by the Ministry of Health, 100 points are allotted to Equipment and 400 points to Methods.

Financial Aspect of Clean Milk Production.—The practical farmer would consider this article very incomplete if some reference were not made to the financial aspect of the subject.

The greatest hindrance to greater cleanliness in the past has been the difficulty, if not the impossibility, of obtaining a higher price for a cleaner and better keeping product. There has at the same time been a lack of recognition of the importance of cleanliness in lessening the losses which occur through the souring of milk and cream; through the production of butter and cheese of bad flavour and low market value and through ill-health and depreciation in dairy herds.

The first point from the financial side, therefore, is that the loss which each dairy farmer suffers from sour milk or similar causes in the course of the year could be greatly lessened by giving a little more attention to the cleanliness of the utensils, the cow and the manner of milking. It is impossible to estimate the value of this loss so far as each farmer is concerned and it is equally impossible to estimate the cost of the extra time and labour required to bring about an improvement. In many cases no extra time is necessary—all that is required is to make better use of the time at present spent in washing of utensils.

The second point is that cows kept under clean conditions are healthier and able to make a more productive use of their food than those housed and milked without any regard to cleanliness.

Dirt brings disease and loss. All-round cleanliness helps to make a healthy herd and increase the milk yield.

The problem of obtaining a better price for a better article is a difficult one, but the prospects for the future are brightening. The initiation of Clean Milk Competitions amongst farmers is a movement of great promise. The awards in these competitions are made on the basis of a bacteriological and chemical examination of the milk and an inspection of the equipment and methods in use at the farm. Diplomas are awarded to those competitors attaining a sufficiently high standard and money prizes provided for the milkers—a welcome recognition of the fact that success in this work, as in so many others, is dependent on the co-operation of all grades of workers. Successful competitors in these competitions have every right to expect, and in some instances have already obtained, a higher price for their milk; further, the result of the efforts made by the others cannot but be beneficial, particularly as a concise report on his own conditions of production is sent to each competitor.

Competitions of this nature, if introduced into other counties by Farmers' Societies, by large wholesale dairy companies or by city councils may well become general and popular, and they will certainly be exceedingly helpful in improving the milk supply at its source in the manner which is least controversial and most successful, namely, by the action of the farmers themselves.

With regard to the production of milk under the strictest conditions of cleanliness, the Ministry of Health has taken over and is carrying on the scheme initiated by the Ministry of Food whereby licences were issued to producers and distributors complying with certain conditions permitting them, and them only, to describe milk produced under such licence, as Grade A and Grade A (Certified) milk.* The demand for and the supply of milk of this high quality at a corresponding price is gradually increasing throughout the country, and though rapid progress cannot be expected, it is a great advance to have a high, but nevertheless attainable standard set up and recognised by the producer, the distributor, the consumer and the Government.

* See H.M.L. 6 and H.M.L. 7 = Licences permitting the use of the designations "Grade A (Certified) Milk" and "Grade A Milk"—obtainable from the Ministry of Health, Whitehall, London, S.W.1.

CULTIVATION OF THE HOP CROP.

IV.—COMMERCIAL VARIETIES OF HOPS.

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IN the description which follows no attempt has been made to enumerate all the varieties of hops grown in England, but the best commercial varieties which are commonly grown in England have been selected and their more important characteristics given.

Characters of Commercial Importance.—The characters of commercial importance in a hop are the following:—

Order of Ripening.—In the list given below the varieties have been arranged approximately in the order in which they ripen, but it will readily be understood that this will vary with season, district and treatment of the hop-garden. A knowledge of the order of ripening may be of use in helping a beginner in planting to arrange his gardens so that the late hops may not be exposed by the picking of the earlies. It is of course necessary with any considerable acreage that the hops grown comprise early and late sorts, so that they can be picked as they successively become ripe, without overtaxing the drying capacity of the oasts, as well as providing a reasonably long hop-picking season for the pickers.

Vigour of Growth.—This character is of importance since it largely determines the width of planting and the height of wire work which should be adopted. It is also to be taken into account in connection with resistance to disease—Aphis ("greenfly"), hop mould and red mould, canker and nettlehead—a very important factor in successful commercial hop-growing, and a subject of which unfortunately there is little scientific knowledge.

Suitability to Soil and District.—For reasons which are little known, varieties are greatly influenced by these two factors, and beginners should only introduce a new variety to a district after a thorough preliminary test.

Ease of Picking.—This factor is important in the cost of production; some varieties can be picked much more cheaply than others, *e.g.*, Fuggle's than the true Golding varieties.

Keeping Properties.—A knowledge of this character gives a guide to the beginner in deciding the sequence of picking—

some varieties will "hang" or "keep" much better than others. It should, however, be remembered that variety is not the only factor; other factors concerned are (1) absence of disease (Aphis or "mould"), and (2) character of soil.

Quality.—This is a peculiarly elusive factor, yet very important; it is likely to be particularly prominent in coming years. Owing largely to ignorance in the brewing trade, the commoner or "flat-catcher" hops have in recent years been more profitable to produce than the better varieties. The tide is now turning in the other direction.

There are two methods by which quality may be judged; firstly, by the senses—the eye, the nose, and the hand ("rub") —which give a good idea of the brewing value, and secondly, by chemical analysis, a method which has not been largely employed because the brewing chemist has not yet decided the relative importance of the various resins and other constituents of the hop. Not until these points are settled, can the plant-breeder proceed to build up new commercial varieties of hops which will be truly economic.

Yield.—This character, while affected within certain limits by various factors, is yet distinctive of the variety.

Male Hops.—It is now generally well recognised that the planting of male hops at the rate of one male to every 200 female "hills" throughout the hop-garden is of fundamental importance. In addition, it is a good plan to plant a number of male hops in the lew row on the S. and W. sides of the garden, because the S.W. wind is the prevailing one at the time of year when the hops are in "burr" and the male hop is scattering its pollen. It has been shown* that the effect of adequate fertilisation of the female flowers (the hop-burr) is to increase the crop by several hundredweights per acre. This has been definitely ascertained with respect not only to such "Golding" varieties as Canterbury Whitebine, Bramling, and Amos's Early Bird, but also to Fuggle's. Another important advantage that is secured by the planting of male hops is that the burr period (during which attacks of mould are most to be feared) is appreciably shortened, since as soon as this is fertilised by the pollen-dust from the male hop it sets into hop.

* Howard, A.: Hop Experiments (Bulletin I, S.E. Agric. Coll., Wye (1904–1905).

Salmon, E. S. and Amos, A.: On the Value of the Male Hop (Leaflet S.E. Agric. Coll., Wye (1908), and in Journ. Inst Brewing, XIV, 309–331 (1908).

Salmon, E. S.: The Pollination and Fertilisation of Hops (Journ. Board of Agric., Vol. XX, 953–966 (1914); Vol. XXI, 22–31, 123–133, 213–220 (1914).)

It should be remembered, however, that the planting of too many male hops in the hop garden will result in the production of too much seed in the hop-cones, and an appearance of seediness in the " side " of the dried hop sample, which is legitimately regarded by the brewer as depreciating the market value of dried hops.

The mere indiscriminate planting of male hops in a hop garden is not, however, sufficient to ensure adequate fertilisation. Other points need attention:—the male hops to be effective, must set free their pollen at the time of the appearance of the " burr " of the particular variety of hop among which they are planted. The male hops therefore need to be distinguished according to the period at which they produce pollen, viz., earlies, mid-season and late, so that one or other of these may be selected for planting with the female variety of similar character. There are, however, some males which flower either so early or so late that their period of pollen-production does not coincide with the burr periods of commercial varieties of hops; these are, of course, quite useless. Again, some varieties of male hops are very susceptible to mould or to the nettlehead disease and such if planted may become the centres of infection of the whole garden; these also should be eliminated.

It is, of course, impossible to prepare a classification of male hops; the fact that the hop plant is dioecious, *i.e.*, the male and female flowers are produced on separate plants, makes it impossible to identify any male hop as being of the same variety as any given female hop.

In the list of the (female) varieties of hops given below, only those have been included which possess the characters necessary for a good commercial variety, viz., a sufficiently vigorous constitution to withstand from time to time unfavourable climatic conditions; the yielding power necessary to produce a remunerative crop; and a crop reasonably easy to pick, which " hangs " well and is of fair quality. Where any variety is superior, or inferior, to this standard, the fact is mentioned under the particular variety.

It may be pointed out that the stock of most varieties on the market is far from pure and contains individuals which are obviously not " true " or of weak stamina. This is particularly the case with Fuggle's, Bramlings and Mathons. It is worth the while of any grower to breed up pure stocks from a single robust plant of many of the older varieties. A reputation once gained for pure stock would lead to profitable business with hop-sets.

For information as to the suitability of some of the varieties to certain districts, and on other points, the writers wish to express their thanks to the following gentlemen:—Viscount Wolmer, Mr. H. Lillywhite, Mr. J. C. Messenger, Mr. E. G. Shew, Mr. W. L. Pritchett and Mr. J. Moore.

Early Varieties.—*Prolific.*—The earliest hop, with very large cones which are easily picked; crops heavily. Little grown on account of its poor quality.

Amos's Early Bird.—Ripens a few days before the Bramling. Suitable for the best loams and Greensands; grown in parts of Kent and Hampshire and considerably in Herefordshire and Worcestershire. This variety, like the Bramling, is liable to be adversely affected by a cold or wet summer, when the cones may be small and difficult to pick. Highest quality.

Bramling.—This variety is universally grown on the best soils throughout the hop growing districts but its acreage is unfortunately declining. Highest quality.

Mid-season Varieties.—*Tolhurst.*—Largely grown in certain districts; grows vigorously on nearly all soils, crops very heavily and is easily picked. Quality poor. This is a favourite variety on account of its cropping powers, but is coming into disfavour on the market on account of its lack of good brewing properties.

Mathon.—Grown only in Herefordshire and Worcestershire on the best loamy soils; in some seasons inclined to make too much bine, which is not fruitful and consequently difficult to pick; keeps well when healthy. Highest quality.

Cobb's.—Grown largely, especially in Kent, on loam and the lighter soils; grows vigorously and crops heavily; easy to pick, but does not keep well. Medium quality. This is a good commercial variety.

Tutsham.—Very similar to the above; with better keeping powers. In order to counteract the tendency of this variety to produce, on strong soils, too much bine, it is the practice in some districts to pull the hills very hard and to train up only the latest bines. This is a good commercial variety.

Farnham Whitebine.—Grown only in Hampshire and Surrey, on good loams. Highest quality.

Fuggle's.—Most suitable for heavy clay soils; grown almost to the exclusion of other varieties in the Weald of Kent and Sussex. Has a vigorous constitution, but is inclined to produce little bine unless stimulated by heavy nitrogenous manuring; crops very heavily in average seasons and does well in wet seasons, but suffers in dry summers; easy to pick; keeps well.

Is a very good "copper" hop, and an excellent commercial variety for heavy soils.

Rodmersham Golding.—Not grown except in a few districts in Kent on good loams. Has a weak constitution and the hills are liable to die away from "canker." Easy to pick. Highest quality.

Late Varieties.—*Petham Golding* and *Canterbury Whitebine.* —Only grown on the best loams, chiefly in Kent. Frequently grow too much bine, and in wet summers develops only a small crop. Highest quality. Although the quality is second to none, the area devoted to the cultivation of these two varieties is now small.

Colgates.—The latest hop; grown on heavy land, chiefly in the Sussex Weald and in Herefordshire. Crops heavily, but the cones are small. A "copper" hop.

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SILAGE FOR MILK PRODUCTION:

A COMPARISON WITH ROOTS AND HAY.

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IN March, 1921, it was decided to discontinue the Ministry's Arable Dairy Demonstration Farm near Denbigh, and the Ministry offered a quantity of silage, then in a clamp on the farm, for the purpose of a feeding experiment.

Owing to the shortness of notice and the rapid approach of the grass season, nothing in the way of an elaborate experiment could be arranged, and as most farmers in the district had large root surpluses, it was not easy to secure a suitable farm for the experiment. Ultimately, Messrs. Hooson, of Brookhouse and Colomendy farms, near Denbigh, kindly consented to carry out the experiment, and grateful acknowledgment is due to them for the ready and willing help they rendered throughout. Milk recording was immediately commenced on their farms to facilitate the selection of two uniform lots of cows.

It was decided that each experimental lot must include at least eight animals, and it soon became obvious that it would be impossible to get two such comparable lots on one farm. As the best arrangement possible under the circumstances, eight cows were selected at Colomendy and eight at Brookhouse.

The following were the two experimental rations fixed upon, the two being estimated to supply similar quantities of starch equivalent (about 12.6 lb.) and digestible protein (2.72 lb.) a day.

Silage Ration.	*Roots Ration.*
40 lb. Silage.	40 lb. Mangolds.
6 lb. Seed Hay.	15 lb. Seed Hay.
4 lb. Oat Straw.	4 lb. Oat Straw.
8 lb. Mangolds.	2 lb. Earth Nut Cake.
2 lb. Earth Nut Cake.	3 lb. Soya Bean Cake.
3 lb. Soya Bean Cake.	1½lb. Oats.
1½ lb. Oats.	1 lb. Barley.
1 lb. Barley.	

It will be seen that in the silage ration 40 lb. of silage was substituted for 32 lb. mangolds and 9 lb. seeds hay. 40 lb. of silage was expected to contain 4.64 lb. starch equivalent and 0.41 lb. of digestible pure protein. 32 lb. mangolds and 9 lb. seeds hay were taken as containing 4.58 lb. starch equivalent and 0.42 lb. digestible pure protein. In making these calculations at the commencement of the experiment it was assumed that the composition of the silage would be similar to that given in Wood and Halnan's Tables for Oat and Vetch Silage. As stated below, it was subsequently found that the silage used did not come up to these figures, and therefore it is probably safe to assume that in the experiment, silage suffered from a slight handicap. The silage was made in 1920 from spring-sown oats and peas, which produced an excellent crop. A shallow pit was excavated in the field and filled with the green oats and peas, the clamp ultimately being carried up to a considerable height, and compressed by drawing the loaded carts over it. The soil thrown out from the pit was then placed on the sides and top of the clamp. When the heap was opened in the following March it was seen that the material had rotted to a depth of about nine inches on both the top and sides of the clamp. Mr. Hooson estimated that the amount of waste was 25 per cent. of the whole, but, unfortunately, there was no means of weighing the material to check this. It is doubtful, however, whether the proportion of weight was really so high. The waste material seemed large in bulk, but owing to the greater solidity of the main mass of the heap as compared with the outside, the weight would probably be much less than the volume of the waste material would suggest. Except for the waste at the outside, the silage taken out in March, April and early May was in excellent condition and very much relished by the stock.

The following is the average analysis of several samples tested by Mr. McLean, Lecturer in Agricultural Chemistry:—

	per cent.
Moisture	76.60
Crude protein (including 2·10 per cent true protein) ...	3·50
Fat	1·05
Fibre	9·15
Ash	2·30
Soluble Carbohydrates	7·40

It will be noticed that these figures show a higher content of moisture and a lower percentage of carbohydrates than many other published figures. This may be due to the exceptional nature of the season of 1920, which was extremely wet and cold, or it may be that silage produced in a west country district is normally lower in feeding value than that produced in the drier and more sunny eastern counties from which most of the available analyses have been obtained.

Plan of Experiment.—The first step consisted in placing all the cows at both farms on the same ration in order to enable the selection for the experiment to be made. This preliminary ration included a small amount of silage so as to accustom the animals to it. Eight cows at each farm with approximately the same total milk yield and comparable as regards age, date of calving, etc., were then chosen. This was done after inspection of the milk records for the 20th, 21st and 22nd of March. This preliminary recording period of three days is admittedly short, but it was found necessary to curtail it as much as possible so as to make it possible to complete the experiment by the end of April.

At the end of the preliminary period the rations of both lots were gradually adjusted so that on the 27th March the Brookhouse cattle were on the full silage ration, and the Colomendy cattle on the roots ration. This was continued for 14 days, records of the milk yields being taken twice daily at both farms. The rations were then gradually reversed so that in the second period Colomendy cows received silage and the other lot had the full root and hay ration. Seven days were allowed for the gradual reversal of the rations.

The following shows the plan of the experiment:—

		Brookhouse.	*Colomendy.*
Preliminary period up to March 22nd	...	**Same rations.**	
23rd to 26th March	...	**Transition.**	
27th March to 9th April (14 days)	...	**Silage ...**	**Roots.**
10th April to 16th April (7 days)	...	**Transition.**	
17th April to 30th April (14 days)	...	**Roots ...**	**Silage.**

Results.—Yield of Milk for Eight Cows.

Period.		*Brookhouse.* lb.		*Colomendy.* lb.		*Remarks.*
March 20th, 21st, 22nd	3 days	555½	Preliminary	558½		
March 23rd to 26th	4 days	710½	Transition	770¾		
March 27th, April 2nd ...	14 days	1,221	Silage	1,243½	Roots	22½ lb. in favour of roots.
April 3rd, April 9th ...		1,192		1,187		5 lb. in favour of silage.
April 10th, April 16th ..	7 days	1,074	Transition	1,178		
April 17th, April 23rd ...	14 days	1,045	Roots	1,188	Silage	143 lb. in favour of silage.
April 24th, April 30th ...		996½		1,166		170 lb. in favour of silage.

Taking the weekly yield of milk there is very little difference between the silage and the roots-fed cows during the first period of the experiment, but during the second period the results are decidedly in favour of the silage ration, there being a difference of 313 lb. of milk in favour of the silage during the last fourteen days.

Average Daily Milk Yield at each Centre.

Period.		*Brookhouse. Average Daily Yield, (8 Cows).*		*Colomendy. Average Daily Yield, (8 Cows).*	
Mar. 20–26	(7 days)	Preliminary period	lb. 181	Preliminary period	lb. 190
Mar. 27–Apr. 9	(14 days)	Silage	172	Roots and Hay	173
Apr. 10–16	(7 days)	Transition	153	Transition	168
Apr. 17–30	(14 days)	Roots and Hay	146	Silage	168

As the experiment proceeded there was a tendency for the yield to drop in both cases, but, during the last fourteen days. while the yield at Brookhouse (on roots and hay) went on decreasing, the yield at Colomendy (on silage) was on the whole well maintained, and it is not unreasonable to suppose that the silage was responsible for this "stiffening" in the yield.

We are indebted to Mr. Arthur Amos of the School of Agriculture, Cambridge, for information regarding similar experiments, the lines of which were followed so far as circumstances allowed.

* * * * * * *

RAILWAY RATES AND AGRICULTURE.

As there seems to be some misapprehension with regard to the rights and opportunities of agriculturists to secure a reduction in the present burden of railway rates, the Ministry has prepared the following memorandum setting out the situation created by recent administration and legislation.

1. By Section 3 (1) (c) and (e) of the Ministry of Transport Act, 1919, Railway Companies whose undertakings were in possession of the Crown were required to follow any directions the Minister of Transport might give as to the rates, fares, tolls, dues and charges to be charged, and such Railway Companies were authorised to charge the rates, etc., directed by the Minister notwithstanding any agreement or statutory provisions then limiting their charging powers.

2. By Section 21 of the Ministry of Transport Act, 1919, a Committee was established called the Rates Advisory Committee, consisting of five persons, two being representatives of the interests of trade and agriculture nominated by the Board of Trade after consultation with the Central Chamber of Agriculture among other bodies, one representing transportation and one labour, with a Chairman experienced in law. An additional member was afterwards appointed by the Minister under a discretionary power conferred by the same section. This Committee was set up for the purpose of giving advice and assistance to the Minister and for safeguarding any interests affected by any directions the Minister of Transport might give as to the charges to be made by the railways, and when considering any question of increase the Committee was to advise the Minister how any increased revenue found to be necessary could best be raised from the various branches of railway traffic.

3. In October, 1919, the Minister of Transport requested the Rates Advisory Committee to advise him as to the best way of raising additional revenue to the extent of £45,000,000 per annum. This sum was subsequently increased by £5,000,000. The Rates Advisory Committee reported to the Minister on 16th December, 1919, and the Minister, in the latter part of December, 1919, adopting the recommendations of the Committee, directed the Railway Companies to increase the tolls, rates and charges published in their rate books by certain percentages and flat rate additions on and from 15th January, 1920.

4. Under the Minister of Transport's direction, and in accordance with the advice of the Committee, agriculture received

preferential treatment, for while rates on coal and coke traffic were increased 25 per cent., Class A 30 per cent., Class B 40 per cent., Class C 50 per cent., and Classes 1 to 5 60 per cent., plus in each case a flat rate addition varying from 3d. to 1s. per ton, such articles as fruit, vegetables, hay and straw were only increased 25 per cent. plus the appropriate flat rate addition. The rates on fresh milk, manure in bulk or packed, basic slag, and lime for agricultural purposes were not increased at all.

5. On 7th July, 1920, the Minister of Transport informed the Rates Advisory Committee that it was estimated the Railways would show a deficiency of £54,500,000 per annum as from 1st April, 1920. As the Government had decided that the Railways were to be on a self-supporting basis, and not to be subsidized by the taxpayer, the Committee were instructed to advise what increase was necessary in rates, tolls, fares, dues and charges to yield by the end of June, 1921 (subsequently extended to 31st July, 1921), the total deficit which had begun to accrue from 1st April, 1920.

6. As the result of the Committee's findings, the increased rates dating from 15th January, 1920, were rescinded and altered tolls, rates and charges on and after 1st September, 1920, were authorised. With the sole considerable exception of manure in bulk, packed manure, basic slag and lime in 2-ton loads for use as agricultural manure in the United Kingdom, which were increased 50 per cent. plus certain flat rate additions, the rates on all traffic in Classes A to C and 1 to 5 (including coal and coke) were increased by 100 per cent. over the rates in existence on 14th January, 1920, plus flat rate additions varying from 6d. to 1s. per ton.

7. On 19th August last the Railways Act, 1921, received the Royal Assent, and by Section 60 of that Act the Railway Companies are empowered until the "appointed day," when standard charges come into force, to make such charges as were in force on 15th August, 1921, which charges are (as respects merchandise) the increased charges mentioned in paragraph 6 which came into operation on 1st September, 1920, subject to the proviso that any representative body of traders may apply to the Rates Tribunal set up under Part III of the Railways Act to reduce the charges now in operation or any of them, and any trader interested in any particular charge may apply to reduce that charge.

8. The Rates Tribunal is a permanent court, consisting of 3 members appointed for a term not exceeding 7 years and in

accordance with Section 20 of the Railways Act, has been constituted as follows:—

Sir F. Gore-Browne, K.C., an experienced lawyer, President; Mr. G. C. Locket, of Messrs. Gardner, Locket and Hinton, a person experienced in commercial affairs; and Mr. W. A. Jepson. late Assistant to the General Manager of the London and North Western Railway, a person experienced in railway business.

9. The Act further provides for the constitution of two panels to be called the General Panel and the Railway Panel respectively. The General Panel is to consist of 36 representatives of Trade and Labour, two of whom are to be nominated by the Minister of Agriculture and Fisheries to represent agricultural interests. The Railway Panel is to consist of eleven persons nominated by the Railway Companies' Association, and one person nominated by the Minister of Transport to represent those railways and light railways not parties to the Railway Companies' Association. The members of the General Panel nominated by the Minister of Agriculture and Fisheries are Sir Walter W. Berry, K.B.E., and Mr. A. E. K. Wherry, O.B.E.

10. When the Rates Tribunal comes to consider any particular agricultural case, two members may be added to the Tribunal, one from the General Panel and one from the Railway Panel, either at the instance of the Tribunal or the Minister of Transport or upon the application of any of the parties to the case, and it is provided that the person to be selected from the General Panel shall, as nearly as may be, be a person with knowledge of the technicalities that may arise in the particular case.

11. The Rates Tribunal is ready to deal with any application that may be made to it under Section 60 of the Act. Information as to the procedure to be adopted, until the permanent rules of the Tribunal are issued, may be obtained from the Secretary at 2, Clement's Inn, Strand, W.C.2. Temporary directions have been issued as a Stationery Office publication.

12. It is probable that the present railway rates will remain in operation for some time, and it is possible that they may continue until the "appointed day" (which is not likely to be before 1st January, 1924), unless the Railway Managers can be induced to reduce them or unless a successful appeal is made to the Rates Tribunal.

As a result of negotiation between the Railway Companies and the organisations representing the interests concerned, the rates between stations in England and Wales on coal, coke

and patent fuel, limestone for chemical works, lime in Class "B" of the General Railway Classification for iron and steel making purposes, and iron and steel in Class "B" have been reduced to the rates in operation on the 14th January, 1920, plus 75 per cent. with a flat addition of 4d. per ton. The Caledonian, Glasgow and South Western, and North British Railway Companies have granted similar concessions, with the exception that the reduced rates on coal, coke and patent fuel apply only when the traffic is forwarded to blast furnaces and steel works. Reductions in the rates for iron-ore, ironstone and limestone for blast furnaces and steel works have also been granted. These reductions apply experimentally for a period of 12 months. It is for Farmers' Organisations to consider therefore what useful action they can take on these lines, or by appealing to the Rates Tribunal, to protect their own industry.

13. With regard to Railway Rates for the future—Part III of the Railways Act, 1921, gives effect to the main recommendations of the Rates Advisory Committee set out in its report to the Minister of Transport dated 22nd December, 1920 (Cmd. 1098), and so far as it relates to the settlement of standard rates may be summarised briefly as follows:—

(1) The Railway Companies will submit to the Rates Tribunal not later than 31st December, 1922 (unless the Minister of Transport extends the time) schedules of rates in the form set out in the Fourth Schedule to the Act based on the classification upon the settlement of which the Rates Advisory Committee are now engaged. Except for the purpose of settling this classification this Committee have now no functions with regard to charges or other matters relating to railways.

(2) The Schedules will be published, and after hearing all parties interested and desirous of being heard, the Rates Tribunal will fix the rates and name a day (in the Act called "the appointed day") when the new rates are to come into operation. These new rates will be called the Standard Rates and Railway Companies will be bound to charge all traffic at these rates unless an exceptional rate has been granted or continued in conformity with the provisions of the Act. The Act provides for the modification of the Standard Rates or any particular Standard Rate at any time after the appointed day upon application to the Rates Tribunal by the Railway Companies or by Traders.

14. The provisions of the Railways Act with regard to exceptional rates are most important, and may be summarised briefly as follows:—

(i) All exceptional rates in operation immediately before the day when the Standard Rates come into force (*i.e.*, the appointed day) will cease to operate, but if a trader interested in any such exceptional rate agrees in writing with the Railway Company before the appointed day for the continuation of his exceptional rate, with or without an increase

of the rate, his traffic will continue to be charged at such rate, provided that such rate is not less than 5 per cent. below the Standard Rate; provided also that if such rate is more than 40 per cent. below the Standard Rate the rate shall, before the appointed day, be referred to the Rates Tribunal, and, if so referred, shall continue until the Tribunal have determined the matter. If the Railway Company refuse to agree, the Secretary of the Railway Company should be notified in writing by the trader that he desires his exceptional rate to be continued and that he requires that the matter be referred to the Rates Tribunal. If this course is taken the exceptional rate will continue until determined by the Rates Tribunal and the onus of proving that it ought to be altered or ought not to continue will be upon the Railway Company.

(ii) No rate which has not been applied to the charging of merchandise actually forwarded within two years preceding the 1st day of January, 1923, shall be continued unless the trader can prove to the satisfaction of the Railway Company or Tribunal that its non-application is due to abnormal condition of trade, or that a rate of equal amount to the same station is in operation from some other place in the same group.

(iii) After the appointed day new exceptional rates may be granted by a Railway Company provided they are not less than 5 per cent. and not more than 40 per cent. below the Standard Rate chargeable and subject to the Railway Company reporting the rate to the Minister of Transport.

(iv) After the appointed day no new exceptional rate may be granted by a Railway Company which is less than 5 per cent. or more than 40 per cent. below the Standard Charge applicable unless the sanction of the Rates Tribunal is first obtained.

(v) If a Railway Company refuses to grant a new exceptional rate any trader may at any time apply to the Tribunal and the Tribunal may grant whatever rate it thinks fit.

15. (i) It will thus be seen that those interested in agricultural rates should examine the schedules of Standard Rates referred to in paragraph 13 hereof with the greatest care as soon as they are published and lay any objections they may have before the Rates Tribunal in the manner and within the time that will be specified when such schedules are published, and take steps to appear before the Rates Tribunal when the schedules are considered so that their rates may be fixed on an equitable basis.

(ii) The Standard Rates as finally settled will be published and notice given of the day when they will come into force. The Rates so settled will have to be carefully examined, and in cases where the existing exceptional Rate applicable to any particular traffic is 5 per cent. or more below the appropriate Standard Rate, and where any hardship would result from the cancellation of such exceptional rate, the Railway Company should be approached with a view to continuing such exceptional rate under the provisions referred to in paragraph 14 (i).

16. The Railways Act further provides that the standard charges and all exceptional charges shall be reviewed at the end of the first complete financial year after the appointed day and at the end of each succeeding year, but the Minister of Transport may direct that no review shall take place as respects any year after the second annual review unless requested by the Railway Company or by the Board of Trade at the instance of any representative body of traders.

17. **Conditions of Carriage.**—Before 31st March, 1922, or within such further time as the Rates Tribunal may permit, the Railway Companies are required to submit to and publish in such a manner as may be prescribed by the Rates Tribunal the terms and conditions on which :—

(*a*) Merchandise other than live stock;

(*b*) Live stock;

(*c*) Damageable goods not properly protected by packing;

will be carried by rail.

The terms and conditions so submitted will be considered and settled by the Rates Tribunal after hearing any representative body of traders who may desire to be heard, or any person who may obtain a certificate from the Board of Trade that he is in their opinion a proper person to be heard, or any other party whom they consider entitled to be heard.

The Rates Tribunal will publish in the London and Edinburgh Gazettes the terms and conditions which they consider just and reasonable, and fix a date, not earlier than two months after such publication, when they shall come into operation.

The terms and conditions so settled shall be the standard terms and conditions of carriage for all Companies and shall be deemed to be reasonable.

18. The jurisdiction of the Rates Tribunal with regard to standard rates and terms and conditions of carriage extends to merchandise traffic by passenger as well as goods trains, but a Railway Company is not under obligation to carry by passenger train any merchandise other than perishable.

* * * * * *

SHROPSHIRE SHEEP.

ALFRED MANSELL.

AT the latter end of 1882 the breeders of Shropshire sheep established the first Sheep Breeders' Association of the world, and in 1883 its first Flock Book was published.

The formation of the Association was hastened to some extent by the great demand which had sprung up during the years 1880 to 1882 for Shropshire sheep for export, mainly to the United States and Canada, and buyers were asking for certificates of purity and origin.

The publishing of a flock book and the issue of export certificates gave a great impetus to the export trade, and it is estimated that no fewer than 20,000 Shropshire sheep were exported during the first decade of the Flock Book's existence, and a steady and remunerative foreign trade has been maintained ever since, either for crossing with Merino or native breeds of sheep, or to found pure bred flocks, which would hereafter furnish rams for a similar purpose.

The position the breed occupies in the United States is shown by the following official statement:—

The total number of pure-bred sheep in the United States on 1st January, 1920, was 463,504. Shropshires come first with 124,453, equal to 26½ per cent., Rambouillets next with 106,819. Merinos follow with 59,876, etc., etc.

History.—The antiquity of the breed is beyond doubt, for Anderson in his "Origin of Commerce" gives the price of Shropshire wool in 1343 as £9 6s. 8d. per sack, and Smith in his History of Wool and Woollen Manufacturers (*Chron. Rusticum*, 1641) quotes the price of Salop (Shropshire) wool as £6 6s. 4d. per sack for home use and £9 6s. 4d. for exportation. Smith further says that the wool of Shropshire was the choicest and dearest in England.

The Shropshire sheep is descended from a breed which has been known to exist from time immemorial on Morfe Common, near Bridgnorth, the Longmynd Hills, near Church Stretton, and Cannock Chase in Staffordshire, though the latter were somewhat heavier sheep and darker in feature than those bred in Salop. It is a down breed of beautiful symmetry on short legs, with lean fleshy back and deep full legs of mutton, with dense wool of best staple and of high quality.

By careful selection and judicious mating of its own variety this popular breed has been brought to the leading position it now occupies. It has been by developing the strongly inherited characteristics of the native breed of the district that all the best flocks have been built up, and when in 1853 at the Gloucester Royal Show the breed was recognised a great encouragement was given to breeders to place their breed in the front rank.

In the work of improvement the breeders were careful to preserve the well-known reputation for hardihood, fecundity, early maturity, and excellence of wool and mutton.

Value for Crossing.—Abundant testimony could be given as to the value of the Shropshire ram for crossing purposes, but the following experiences, selected out of many, are convincing:—

Mr. John Gregg, of New Zealand, in an article on "The best Mutton Sheep" about 20 years ago, says: "I use nothing but Shropshire rams on my crossbred ewes. I find that my Shropshire wool or a strong dash of that blood gives about 1½d. per lb. more than any coarse crossbred."

Mr. G. S. Kempe, writing on the Midland Association's Show at Campbeltown, Tasmania, in 1900, says Shropshires in Tasmania have secured a very strong foothold. Lambs for the export trade need to be "thick in flesh, light in offal, solid, square, well coupled behind, and early maturing," and these qualities may be looked for from the Shropshire cross with either the Merino or Lincoln ewe on almost any pasture or in any climate which can keep sheep profitably.

In New Zealand equally good results are obtained, *vide* the following remarks from an eminent firm of London Meat Salesmen, in February, 1896:—

"In answer to your enquiry the most popular sheep and lambs from North Canterbury (New Zealand) are Shropshire crosses, and pure Merinos have simply no chance against them from a butcher's point of view. The New Zealand Shropshire cross lambs are especially acceptable amongst high-class frozen meat butchers."

In an able Paper on crossbred sheep read at Buffalo, U.S.A., Professor Shaw, of the Ontario Agricultural College, after referring to the improvement of the Merino without lessening the value of the wool, and the breed or breeds best adapted for that purpose, says it is a fact that some breeds do not answer as well as others. He further says that the only sure evidence that we can have that one breed will be able to effect improvement in another is that furnished by actual demonstration. Tried by this test the Shropshire ram has been found eminently adapted for the purpose of improving the average foundation stocks

(Merinos and Merino Grades) in the United States. Continuing, he says the Shropshire ram blends admirably with the Grade Merino Stock, covering the bony framework with lean and juicy meat, widening the body and making it deeper and thicker throughout. It also blends well with the grade Leicester sheep by increasing their hardihood and improving the quality of the meat by intermingling fat and lean.

As recently as 1912 four of the largest firms in Australia (W. Angliss & Co., John Cooke & Co., T. Borthwick & Sons, Ltd., and Sims, Cooper & Co.) operating in the export trade, addressed a letter stating that, as the largest exporters in the trade in Victoria and also doing extensive business in South Australia and New South Wales, they felt it only right and their duty to sound a note of warning and at the same time give advice to breeders. They state that—

"In the early years of the export lamb trade in Australia it was largely built up and made successful by breeders using pure Shropshire rams, the crosses from which we have proved by experience are eminently fitted for the best English trade. Maturing quicker than most other crosses, the Shropshire lamb at the earliest possible age is good in the most valuable joints, back, loin and leg, and running to meat rather than fat, gives better results in dressed dead weight in proportion to live weight than any other cross we know of.

"For some years the majority of breeders followed the right track and bred the Shropshire cross, but the last two or three seasons, owing largely, we believe, to the rise in cross-bred wool, the majority have swung the other way and tried to breed an export lamb got by sires of other breeds, with very varying results, trending, however, in the wrong direction. The consequence is that we now find it impossible to get as big a proportion of lambs fit for the best home trade as formerly, these other crosses compelling a larger number of rejects than is usual from the Shropshire, and those accepted not being equal for our purposes to that cross.

"And as regards seasons, our experience is that the Shropshire cross in a bad or indifferent season will come out even better in proportion than in a good one, when compared with other breeds, as regards percentage fit for export. So we must warn breeders that they are on the wrong track in dropping the Shropshire, and our advice to them, if they want to help us to expand this trade and make Australian lamb more popular and a better price in the old country, and therefore more payable to the breeder, is to go in again largely for the Shropshire. Not for a moment do we want to disparage other breeds. All have their good points for their own special purposes, but we say unhesitatingly that throughout Australia for the export lamb trade we have found the Shropshire cross the best. Breeders must remember that the export trade can never be fostered and developed as it should be by their trying to make the home trade a dumping ground for simply unsuitable surplus stock bred for wool as the first and main consideration, and that if they value this trade and desire to increase it to the immensity we believe possible, then they must cater for the trade and breed a lamb suitable for the best English customer."

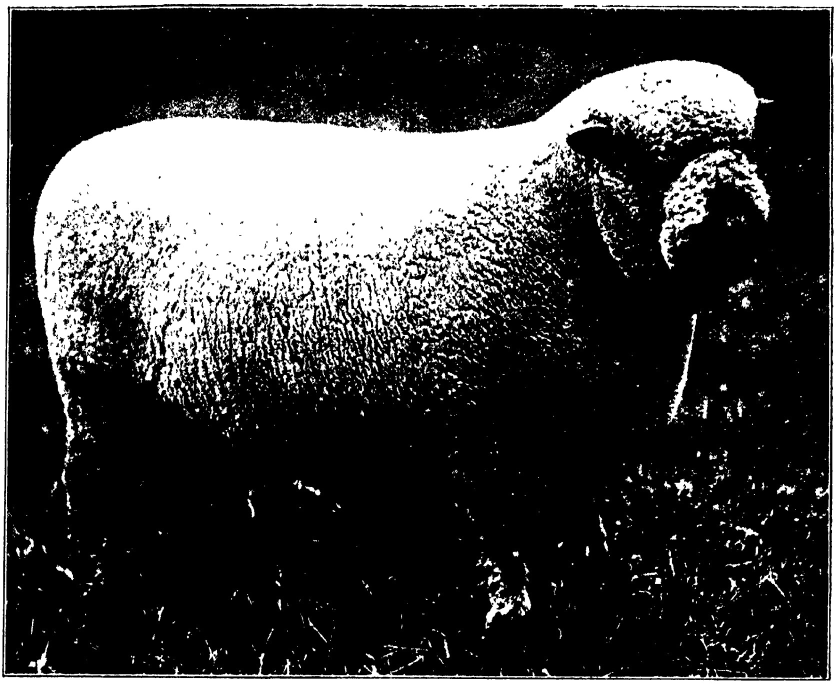

Fig. 1. Shropshire Ram.

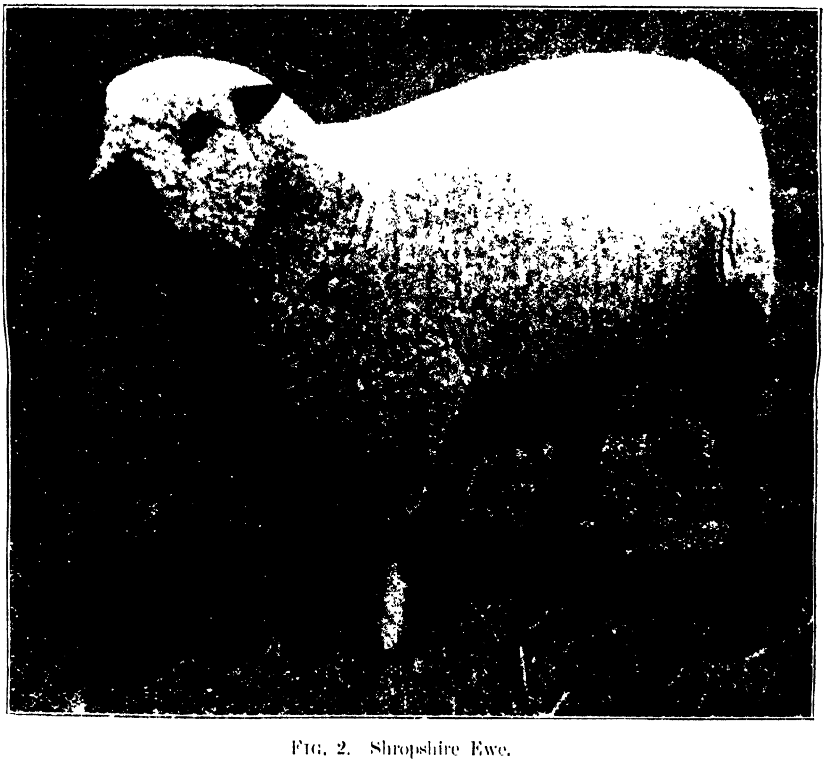

Fig. 2. Shropshire Ewe.

Wool.—The quality of Shropshire wool can be classed as 50 to 56, with a staple of nice length, dense, fine in texture, and always readily saleable. Mr. S. B. Hollings, the Bradford Wool Expert, reporting on wool from a Shropshire-Merino cross, the property of Mr. W. A. Hart, of South Africa, writes as follows:—"It was sound in staple, very shafty, nice combing length, very clear, and free from wasty matters, though in the grease, and a good colour. The quality, as can only be expected, was hardly of a 60's count, it being classed as a 56's wool, but for all that, in a blend of wool for 'tops' of our average 60's, such as is largely consumed in Bradford (England) it would have been used most readily."

This good opinion of the wool was subsequently confirmed by wool experts on Bradford Exchange, and also by two noted wool brokers, Messrs. H. P. Hughes & Son and Messrs. Buxton, Ronald & Co.

Then again, at the Royal Show at Darlington in 1920 Mr. E. Craig Tanner's Shropshire Wool exhibit won the Champion Prize offered by the British Wool Federation for the best exhibit of wool in all the classes, a unique and highly prized distinction. Sixteen pure breeds of sheep were represented, in addition to four classes for crossbreds.

Showyard.—The establishment of the Shropshire Sheep Breeders' Association in 1882, combined with the great export demand, induced breeders to enter the Showyard, with the result that at the Royal Agricultural Show held at Shrewsbury in 1884 no fewer than 875 Shropshire sheep were exhibited, against 420 of all other breeds added together. At this Show 60 breeders exhibited, hailing from many counties, including Ireland.

In the United States and Canada Shropshires are far more largely represented than any other breed. At the Chicago (U.S.A.) Show of 1921, the Grand Champion Wether, beating all breeds in open competition, was a Shropshire, exhibited by Mr. Jesse Andrews.

Prices.—Shropshire Sheep have for many years (fully 40) commanded high prices, rams ranging up to 400 guineas, ram lambs to 180 guineas, ewes up to 70 guineas and ewe lambs to 40 guineas. These are of course for exceptional specimens, but at the same time good Shropshire Sheep have always found a ready market at very remunerative prices to the breeders. Prices naturally vary according to the reputation of the flock and the quality, but at the present time the best class of rams can be bought at from 80 guineas to 150 guineas, and useful sorts

from 20 guineas to 40 guineas. The best class of ewe will now cost from 12 guineas to 15 guineas, and a very useful class of ewe from 7 guineas to 8 guineas.

Type.—The best type of Shropshire should possess (particularly in the male) a well-developed head, with clean and striking expression of countenance, a muscular neck well set on good shoulders, the body symmetrical and deep, placed as squarely as possible on short strong legs, due regard being paid to grandeur of style, the face and legs should be a nice soft black (not sooty) the head should be nicely covered, and the wool generally should be fine, of great density and length of staple.

The skin should be nice cherry colour and the belly and scrotum (in the males) should be well woolled.

Objections.—Horns in ram; speckled face, ears or legs; long heavy ears; thin open wool.

In all breeds there are more or less two types, and it is to a certain extent the case with Shropshire Sheep. Some favour the short-legged, symmetrical, deep, lean-fleshed sheep, covered with a dense heavy fleece, while others prefer the longer-legged animal with more size, and possibly a little more bone. Personally I have always considered the Shropshire Sheep as a medium-sized sheep of good quality with a robust constitution, maturing early at small cost, admirably adapted as a general purpose sheep. What I wrote some years ago I again repeat, and it fully expresses my views on medium versus large sheep. Some farmers prefer a big, coarse sheep on long legs, but I am quite convinced of this, that the best rent-paying class is the moderate-sized sheep of good quality, because the butchers can sell them the more readily and at better prices, and a greater weight per acre can be raised than where the larger and coarser sheep is resorted to, for 100 ewes in the former instance require as much land for their support as 130-140 well-bred moderate-sized ewes.

Fecundity.—150 to 175 lambs per 100 ewes is the usual average. A census which the writer took some years ago from 11,666 ewes gave a return of 168 lambs per 100 ewes, and in addition to this Shropshire ewes are excellent mothers and great milk yielders.

Adaptability and Hardihood.—The breed flourishes in every county in England, the humid climate of Ireland, the Highlands of Scotland and the mountainous districts of Wales, at altitudes up to 1,000 feet above sea level, and it is equally at home in every country in the world.

Descended originally from a semi-mountain breed, it is notoriously strong in constitution, and capable of withstanding extreme variations of heat and cold and is one of the most hardy breeds in existence. During the prolonged droughts which periodically visit Australia the hardihood of the Shropshire Sheep has been strikingly exemplified. Mr. Ralli, of Balaclava, South Australia, on his return home, wrote as follows:—

"I arrived home all right, and found that 32 per cent. of my flock sheep had perished during the 1906 drought, although the run was 23 per cent. understocked, and that, instead of marking several thousand lambs, some 500 were all my share for the year's increase. I must tell you 68 per cent. of my Merino ewes died, and that those left only gave 8 per cent. of lambs. whilst the Lincoln cross-bred dry sheep lost 48 per cent. of their numbers. And now for a Shropshire comparison with these breeds. I lost one ewe of my stud flock, and this by a dog, and the sheep, Mr. Kempe tells me, had by no means the best of the country to live on, and were wholly unfed by artificial means; but the best test of their hardihood comes from the grade flocks. These numbered one-fifth of the sheep; their loss has been but 8 per cent., and their increase 55 per cent. Mr. Kempe also tells me these grades had more to withstand than the others, as they were thought to be hardier, and so were given worse country to run on. This evidence of the Shropshire's value to this country of uncertain rainfall is to me overwhelming."

Management.—A few words about management of Shropshire Sheep. These sheep in their native counties are not kept all the year round between hurdles like some breeds, but are run on the pastures a good deal. When required they are good folding sheep, and do very well on roots, kale, cabbage, etc.

Shropshires do not require a large amount of corn, in fact they do better on moderate allowances of artificial food and are really very economical feeders. The secret of management is to keep the lambs going from birth and arrange for a steady supply of suitable green foods.

A great point with lambs is to keep them on land which has not previously been heavily sheeped, and the more often the land is turned over by the plough the less the danger of parasitic disease. The usual custom is to mate the ewes to drop their lambs from the end of January to mid-March, and great care is taken in the mating both as regards conformation and pedigree. It is the usual practice to put them on fresh pastures at this period (rutting season). It is considered that it usually results in an early and prolific fall of lambs.

After the mating season is finished the ewes run on old pastures without any artificial assistance except in inclement weather, and as the season advances trough food is usually given, but great care must be taken to have a good supply of troughs.

and so avoid crushing. This artificial help usually consists of a mixture of oats, bran, and linseed cake, or boiled linseed mixed with a small amount of pulp and cut stuff. Feeding pregnant ewes entirely upon a dry ration is not recommended, but at the same time roots should be used vary sparingly.

It is considered of great importance to get the ewes and lambs from the lambing fold as early as possible, and for this purpose the young seeds supply all that is wanted, and in the case of twin lambs the ewes are put on a generous diet and when possible the lambs are allowed to run forward. The pasture is often supplemented with roots, kale and cabbage.

Weaning usually takes place at the end of May or early in June according to circumstances, but it is found in practice that the food supplied at weaning time should be of a highly nutritious character and such as can be easily assimilated. Fresh seeds, supplemented with artificial food, with vetches, kale, or cabbage, provide all that is required. This carries the lambs to early autumn, when they are folded on roots, kale, etc.

It is the usual custom to keep the breeding ewes during the summer on the poorest pastures that the farm affords, otherwise they are apt to lay on more flesh than is desirable in a breeding flock.

To provide the young sheep with a regular rotation of green crops and other suitable foods the breeder must exercise considerable forethought. This can easily be done by planting so much winter tares and rye in the autumn; following up with spring tares, early Enfield Market cabbage, planted in February or March, according to the weather; the drilling of the early Enfield cabbage, early sheep fold and ox cabbage at intervals during the spring and summer months; assisted with white turnips, rape, kale, kohl rabi, in suitable quantities. A large flock can be kept in this manner.

* * * * * *

THE LARGE BLACK PIG.

SANDERS SPENCER.

THIS is another of those breeds of pigs which have increased enormously in popularity since a society was formed to register the pedigrees of the pigs of the breed and to protect the interests of its breeders. Unlike the Cumberland and the Gloucester Old Spots the Large Black appears to have had a dual origin, as large pigs of a black colour were bred to a considerable extent in the Counties of Essex, Suffolk and a portion of Cambridge

and also in the South-West of England long before the first pig society was formed. The black pig of the Eastern Counties was a long pig square in the quarters, with light fore end, rather flat ribs, fine in the hair, skin and bone, and somewhat long in the face and on the leg. The sows were prolific, and very good milkers; the young pigs were hardy and quick growers. These pigs were eminently suited to the outdoor life they led as most of the sows and the store pigs had the run of the pastures near the homestead during the winter and in many instances were folded or ran loose over the temporary grasses, mainly clovers sown on the arable lands, alternately with peas or beans each four years. A considerable number of these black pigs were also fattened on "seeds," the additional food usually being the beans or peas grown on the farm. This feeding off the clovers and annual grasses with pigs was considered to be a splendid preparation for the following wheat crop.

The large black pig common in the south-western counties was of a somewhat different character, being shorter in the head, body and legs. heavier in the jowl and shoulder and not so square in the hind quarters nor so good in the hams. The variation in substance and the amount of fat carried might have been due in part to the climate and to the varying food requirements of the miner with his very severe toil and the less arduous employment of the Eastern Counties' residents. The Cornish large black shared with the Essex type those very valuable characteristics, prolificacy, free milking, hardihood and quick growth when young.

The south-western large black pig was not generally known beyond its borders until the bacon factory was built at Redruth. For some time nearly the whole of the fat pigs killed thereat were of the large black type common within the district. Although the factory was well equipped and managed on scientific principles the bacon failed to command the best prices on the markets beyond the district. The sides of bacon were declared to be too heavy in the fore-end, too short and with hams of a shape not suitable for the best markets. Some of the bacon was also said to be too fat and the bone too heavy. Boars of another colour were introduced but the local prejudice in favour of the black colour was great.

A few years earlier, consumers of pork and manufacturers of bacon had become dissatisfied with the short, thick and compact pig with an excessive proportion of fat which had become general in the Eastern Counties. One of the results of the

objections raised and of the discussion in the Press was the rehabilitation in public favour of the long-backed lean-fleshed large black which furnished long sides of lean bacon but was not so well suited for the fresh pork trade. A happy idea was acted upon by some Eastern Counties' pig breeders who proceeded into Cornwall for the purpose of inspecting the Cornish type of large black pig. It resulted in the purchase of a number of the thick compact and heavy-fleshed pigs which when crossed with the boars of the Eastern Counties large black produced a far more suitable pig for bacon curers than could possibly be bred from a pure South-Western or Eastern Counties bred pig. The interchange of breeding pigs between the two distant districts resulted in the evolution of a black which can fairly claim to be the equal of any breed of pig for the production of large litters of quick-growing and early-maturing pigs. There is much to be said in favour of the claim that no breed of sow when crossed with a suitable white boar is superior, if equal, to a Large Black sow in the production of pigs for the highest price bacon.

The Large Black pig has extended to all parts of England and Wales and has actually invaded Scotland, where until quite recent years the breeding of pigs was by no means general or popular. Many Large Black pigs are also found in Ireland where the sows are very successful in producing pigs for the bacon factories when crossed with the thick type of Large White or Large White Ulster boars . It is also claimed that no breed of imported pig can withstand the climate of South Africa so well as the Large Black. For some reason, not explained, pigs of nearly all other pure breeds degenerate quickly in South Africa, where the dairying and bacon industries are fast becoming very important, so that it is possible that the export trade in Large Black pigs to tropical or semi-tropical countries is likely to become of considerable extent. No further proof of the great popularity of the Large Black pig in the British Isles is required than the fact that the members of the Society number about 1,700.

The revised scale of points is as follows:—

Head.—Medium length and wide between the ears ...	5
Ears.—Long, thin, inclined well over the face, with nose of medium length	4
Jowl.—Medium size	3
Neck.—Fairly long and muscular	3
Chest.—Wide and deep	3

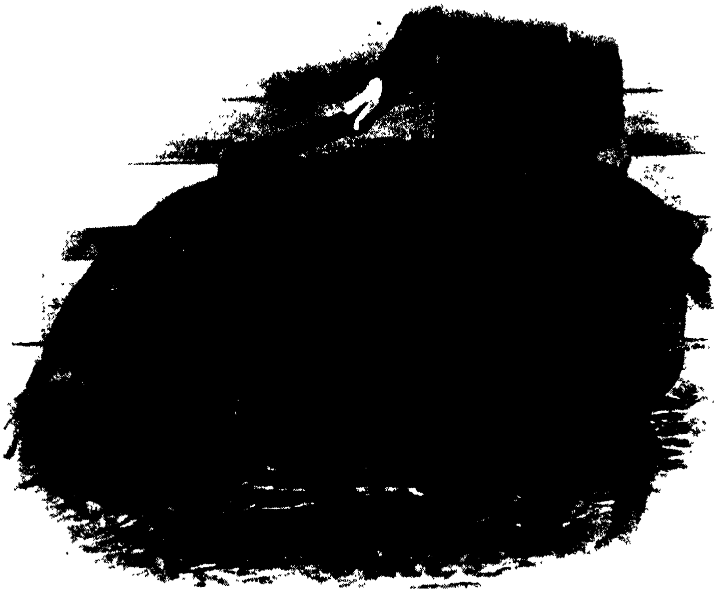

FIG. 1.—Large Black Sow.

FIG. 2. Large Black Boar.

Shoulders.—Well developed, in line with the ribs ...	8
Back.—Long and level	15
Ribs.—Well sprung	5
Loin.—Broad	5
Sides.—Very deep	8
Belly and Flank.—Thick and well developed	7
Quarters.—Long, wide and not drooping	8
Hams.—Large and well filled to hocks	10
Tail.—Set high, of moderate size	3
Legs.—Short, straight, flat and strong	5
Skin and Coat.—Fine and soft, with moderate quantity of straight silky hair	8
	100

Objections.

Head.—Narrow forehead or " dished " nose.
Ears.—Thick, coarse or pricked.
Coat.—Coarse or curly, with rose; bristly mane.
Skin.—Wrinkled.

Disqualification.

Colour.—Any other than black.

* * * * * *

DEPTH OF SOWING GRASS AND CLOVER SEEDS.

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THE cultural operations connected with the covering of grasses and clover seeds vary considerably, not only in different parts of the country but very often on different farms in the same district. The underlying principles of many of these operations are diametrically opposite: for instance, some authorities hold the view that the best results are obtained by merely sowing the seeds on the surface during a wet spell, while others advocate drilling the larger seeds, such as rye grasses, tall fescue and cocksfoot along with the seeds of the nurse crop, thus covering the seeds to relatively great depths.*

The covering operations commonly practised bury the seeds to varying depths intermediate between these two extremes. It

* "A better way to lay down land to pasture." By Professor T. Wibberley. Hunter's Annual Price List, 1920.

is the practice of some to cover the seeds lightly by merely rolling them in; others aim at covering the seeds more deeply by using various kinds of harrows—chain, bush, and peg harrows, or a special seed harrow. Moreover, the depth at which the seeds are buried not only depends on the kind of harrow used but also on the number of times the operations are repeated. A coulter drill or the Cambridge roller fitted with a special seed box is not infrequently employed.

As a general rule the nature of the soil and the depth requirements of the different seeds are not taken into consideration when deciding on the method to employ; this is generally based on the custom of the district.

In view of the general tendency to increase the acreage under grass and the losses which frequently occur as a direct result of poor take, which are the more serious in the case of leys intended to be left down for a number of years, greater attention should be paid to field problems connected with laying down land to grasses and clovers.

The best depths for sowing seeds of different cereals have been investigated by Perkins and Spafford in Australia,* while the best depths for sowing red-clover seeds have been investigated at Wisconsin and Michigan Experiment Stations, U.S.A.† As far as the writer is aware, but few experiments dealing with grasses and clovers have been previously carried out in this country.‡

Aims and Description of the Experiment.—The investigations here discussed were carried out during 1919 and 1920 with the following species:—

Clovers.—Red Clover.
White Clover.
Grasses.—Perennial Rye Grass.
Cocksfoot.
Meadow Foxtail.
Rough Stalked Meadow Grass.

Pot Cultures.—A preliminary experiment was conducted at the laboratories with numerous pot cultures.

All pots used were of uniform size. The soil had been air dried. The seeds were sown on the surface and at depths of

* Experiments Relating to the Depths of Sowing of some Agricultural Seeds. By Perkins and Spafford. Journal of Dept. of Agriculture, South Australia, Vol. XV, Nos. 3-6, 1910.

† Forage Plants and their Culture. By Charles V. Piper, 1914.

‡ Findlay has conducted experiments with Red Clover, but does not give detailed results: see Red Clover, Bull. No. 24, The North of Scotland College of Agriculture, by Wm. M. Findlay, N.D.A.

$\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, 1, and $1\frac{1}{4}$ in.; these eight depths constituted a series.

The method of procedure adopted in preparing the pots for germination was as follows: Each pot was first filled to the required depth—marked on the pot—with a definite amount of soil in accordance with the volume of the pot below the depth mark. After the soil had been carefully levelled to the depth mark 100 seeds were sown at 1 cm. apart. The seeds were covered to the appropriate depth by filling the pot with a calculated weight of soil, which was then compressed and levelled to the "surface mark." By this method all the pots received equal weights of soil, which occupied equal volumes and which was compressed to the same degree of compactness, while the seeds were buried to the exact depths required. The pots received the same initial amount of water, and were afterwards watered every two or three days as required. Each series was allowed to germinate at room temperature and was treated alike in all respects. The number of surface seedlings was counted every seven days. For the purpose of these experiments the term "surface seedlings" is applied, in the case of surface sowings, to seedlings with radicles properly fixed in the soil, and in the case of covered sowings only to seedlings which had reached the surface.

Box Cultures.—During May, June and July, 1920, a similar experiment was carried out in boxes in the open, but protected from birds by means of a wire cage. Seeds were sown on the surface and at eight depths from $\frac{1}{8}$ in. to 3 in., 500 seeds being sown in each box in rows 1 in. apart and $\frac{1}{3}$ in. between the seeds in the rows. The ordinary soil, which had been freed of stones. was used for this purpose. The method of procedure adopted in preparing the boxes for germination was similar to the method described under pot cultures; the surface seedlings were counted every 14 days.

Bed Cultures.—This experiment was carried out on duplicated beds 42 in. by 18 in. on one of the Station's experimental grounds. 500 seeds were sown in each bed in rows 2 in. apart and $\frac{3}{4}$ in. between the seeds in the rows. The different depths were gauged by means of a graduated wooden frame of the same dimensions as the beds. The frame was pressed into the soil until the required depth was reached. The soil was then removed and the floor of the frame carefully levelled. The seeds were covered by replacing the removed soil, which was pressed down to the original surface mark.

Table showing (a) *the percentage number of Surface Seedlings, and* (b) *the weight of Green Fodder given by various species of Grasses and Clovers when the seeds were sown at different depths.*

	Red Clover Germination = 94 °/。			White Clover Germination = 98 °/。		Perennial Rye Grass Germination = 89 °/。			Cocksfoot Germination = 80 °/。		Meadow Foxtail Germination = 66 °/。		Rough Stalked Meadow Grass Germination = 70 °/。	
	Surface seedlings percentage		oz. Green Fodder	Surface seedlings percentage		Surface seedlings percentage		oz. Green Fodder	Surface seedlings per centage	oz. Green Fodder	Surface seedlings percentage		Surface seedlings percentage	
Experiments ...	Pots	Boxes and Beds	Beds	Pots	Boxes	Pots	Boxes and Beds	Beds	Boxes and Beds	Beds	Pots	Boxes	Pots	Boxes
No. of seeds sown at each depth ...	800	1500	1000	400	500	800	1500	1000	1500	1000	600	500	600	500
Days after sowing ...	40	28	—	28	28	35	28	—	28	—	42	31	49	49
Surface (uncovered)..	36	43	6	67	75	80	51	18	57	4½	25	46	57	32
⅛ inch	93	90	20	98	81	86	73	49	69	11	15	62	27	35
¼ inch	91	90	16	97	90	83	72	57	64	15	21	49	16	27
⅜ inch	85	89	13	97	92	85	72	47	63	12½	23	48	14	24
½ inch	66	87	9	96	91	84	72	49	65	10	23	42	11	21
⅝ inch	54	—	—	95	—	86	—	—	—	—	22	—	10	—
¾ inch	43	89	8	96	86	86	71	54	59	8½	19	43	9	9
1 inch	68	85	6	94	66	83	66	50	50	5½	23	42	4	6
1¼ inch	59	—	—	84	—	82	—	—	—	—	18	—	2	—
2 inches	—	53	very small	—	2·4	—	48	21	16	1	—	5	—	0
3 inches	—	6	0	—	0·4	—	10	4·	0	0	—	0	—	0

Owing to the abnormally wet weather experienced during the summer of 1920, the sowing of this experiment was postponed until the latter half of August: unfortunately the season proved to be too late for sowing white clover, meadow foxtail and rough stalked meadow grass, and as the germination was too poor the seedlings of these species were not counted.

The numbers of surface seedlings of the other three species were counted four weeks after sowing, while the produce from the duplicate beds was cut and weighed about eight months after sowing (8th April, 1921). At the same date the number of tillers per plant was counted on 50 typical plants from each bed.

The number of seeds employed in these three experiments was :—

Pot Cultures	26,800	seeds.
Box "	27,000	"
Bed "	54,000	"
Total ...	107,800	"

Soil.—The soil used in the pot and box experiments was taken from the plot on which the beds were sown. It was a light loam, which is the typical soil of the district.

Seeds.—The seeds used in the three experiments were carefully selected from the same bulks. All light and imperfect seeds were discarded, while the clover seeds were rubbed between sandpaper so as to reduce the number of hard seeds present; the rubbing had the effect of increasing the percentage germination of red clover from 81 to 94. The selected seeds were tested for germination before commencing the investigations.

Red Clover.—A glance at the Table will show that the number of surface seedlings at depths of ⅜ in. and over was very considerably lower in the pot cultures than at corresponding depths in the box and bed cultures. The poor results given by the pot cultures can be explained by the fact that the seeds were sown much too thickly in the pots—about 10 times as thickly as normal field seeding. As a result, the layers of soil overlying the seeds were completely raised by the pressure exerted by the very broad cotyledons of the seedlings, so that practically the only seedlings that reached the surface were those which were fortunate enough to work their way up through the cracks in the soil.

A comparison of the results given by the different depths in the box and bed experiments proves very conclusively that red clover seeds should never be left uncovered. Covering the seeds

to the very shallow depth of $\frac{1}{8}$ in. had the effect of increasing the number of surface seedlings by more than 100 per cent. It is also equally clear that only failures in "take" may be expected when the seeds are covered to depths of 2 or 3 in. since at 2 in. only 53 per cent. reached the surface while the 3 in. depth gave only 6 per cent. of surface seedlings.

These experiments show that the best results are obtained when the seeds are buried to a depth of not greater than 1 in. To ensure that the seeds are properly covered a method of covering by which the seeds are buried to average depths of $\frac{1}{2}$ in. to $\frac{3}{4}$ in. should be adopted. Moreover, the young seedlings will not run so much risk of being killed off as a result of a sudden spell of dry weather at these depths as they would if covered too lightly. Although $\frac{1}{8}$ in. to $\frac{1}{4}$ in. beds gave heavier yields than the $\frac{1}{2}$ in. and $\frac{3}{4}$ in. beds in a very wet season, it is highly probable that these yields would be reversed in a normally dry year.

It appears from the following figures, which give the average number of stems per plant at about eight months after sowing, that surface and deep sowings (*e.g.*, 1 in. and 2 in.) have a detrimental effect on stem formation during the early stages in the life of the plants:—

Depths	Surface	$\frac{1}{8}$ in.	$\frac{1}{4}$ in.	$\frac{1}{2}$ in.	1 in.	2 in.
Number of stems per plant	2·2	3·0	2·8	3·2	2·6	2·4

The Causes of Failure of Surface Sowings.—When the red clover seeds are left uncovered the thick radicles of the seedlings are unable to enter the soil immediately germination takes place. This is partly due to the very blunt nature of the root tips and partly to the fact that the root hairs are too short and matted to act as such efficient organs of anchorage as in the case of certain of the grasses. As the radicles and hypocotyls increase in length the seeds are pushed back often to a distance of $1\frac{1}{2}$ in. before any of the seedlings become fixed, but if the seeds are held in position by a light covering of soil the radicles are able to force their way into the soil at once. That this is the case was proved by the following experiment. Seeds were sown on the surface in four pots. The seeds in two of the pots were lightly pegged down by means of notched matchsticks, the other two pots were kept as controls. The results 10 days after sowing are given below:—

	Percentage Germination.	*Percentage seedlings with radicles fixed in the soil.*
Pegged ...	95	84
Unpegged ...	92	4

A rough surface very materially assists the seedlings to become attached to the soil. Two series of tests were put up: in one case the seeds were sown on the surface on soil previously pressed and in the other on a non-pressed surface; in the former case 35 per cent. and in the latter 63 per cent. of the seedlings became fixed to the soil. It would thus appear obvious that the soil should not be rolled prior to sowing when it is not intended to cover the seeds.

Germination is slower from surface than from covered seeds; and especially so if the soil is inclined to be fairly dry. The following figures giving the percentage of germination fourteen days after sowing show the extent of the difference:—

	Surface.	*At $\frac{1}{8}$th in.*
Pot Cultures	52	88
Box "	36	90

Effect of Light on Germination.—That light has not the same detrimental (or even any retarding) effect on the germination of red clover seeds as it has on the germination of certain grass seeds* was shown by the following experiment. In order to equalise evaporation a number of surface sown pots were covered with large petrie dishes, half of which had been made impermeable to light by covering them with thick, brown paper. Both series were allowed to germinate under normal room conditions. The average results after 10 days' germination were:—

	Germination.
Exposed to light	95 per cent.
Kept in the dark	90 per cent.

The Behaviour of Red Clover Seeds when Covered at different Depths.—The seeds were sown at 12 depths varying from $\frac{1}{8}$ in. to 6 in. round the sides of large glass tubes in order to keep the seeds and seedlings under observation. The tubes were covered with brown paper and kept in a dark room at ordinary temperature (maximum about 12° C.).

It was found that the seeds germinated equally well and at about the same rate at all depths down to 4 in.—the percentage germination at these depths only varied from 75 per cent. to 85 per cent., but at 5 in. only 10 per cent. of the seeds germinated, while at 6 in. not a single seed germinated although water was imbibed by the seeds. The failure of the seeds to germinate at depths of 5 and 6 in. was no doubt due to lack of

* Contributions regarding the germination of unhulled and naked Timothy seeds. By M. Heinrich, Landw. Versuchst. 93; Botanical Abstracts, Vol. VII, No. 3, 1921.

sufficient air at these depths, since the other factors controlling germination were constant for all the tubes.

The percentage number of seedlings that had reached the surface in 22 days after sowing is given below:—

Depth.	*Percentage Surface Seedlings* *
⅛ in.	65
¼ and ⅜ in.	75
½ in.	55
1—6 in.	0

This experiment shows that red clover seedlings are unable to reach the surface when sown too deeply, and this mainly on account of the large surface which the broad cotyledons offer to the resistance of the soil. When buried at depths of 1 to 4 in. the pressure was so great that the hypocotyls of many seedlings were forced to assume a horizontal position, some being bent right back and forced to grow in the same direction as the radicles. Even at the fairly shallow depths of ¾ to 1 in. the seedlings experienced considerable difficulty in working their way through, as was shown by the very tortuous course followed by the much thickened hypocotyls.

Conclusions.—(1) The best depth at which to sow red clover seeds in light loamy soils appears to be ½ to ¾ in.†

(2) Only a very small percentage of the seedlings may be expected to establish themselves if the seeds are left uncovered.

(3) Many of the seedlings are unable to reach the surface if the seeds are buried to depths of over an inch.

(*To be concluded.*)

* * * * * *

* The soil in the tubes was pressed very hard, hence the reason for the percentage of surface seedlings being lower than in the pot experiments.

† cf. Findlay (loc. cit.) who states that he obtained the best results when the seeds were covered by about ½ in. of soil; he also states that it is necessary to sow the seeds deeper on a dry than on a wet soil.

THE WORTHING FRUIT GROWING INDUSTRY.

A. G. LEENEY.

IN that part of Sussex which is bounded by the river Adur on the east and the Arun on the west there lies, between the South Downs and the sea, a tract of land some fifteen miles by four miles, whereon has been developed the Worthing fruit growing industry.

The natural advantages are many: the soil for the most part is rich and deep, the hills to the north are of sufficient height to keep off the cold north and north-east winds, while the L.B. and S.C.R. line from London to Brighton and Portsmouth, with stations every two or three miles, runs through the centre of it, providing an efficient service to London and the northern markets. There is an unfailing water supply, ample sunshine and an average rainfall.

Worthing's fruit fame goes back some 600 years, when the great Archbishop, Thomas-à-Becket, had a country residence at West Tarring, now a part of the borough of Worthing, in the garden of which he grew the luscious figs which for many centuries constituted Worthing's chief claim to fame in the fruit world. Figs are still grown, although Worthing has now to give the palm for quality to Guernsey. In the Worthing district there are now some 250 fruit growers, who between them employ somewhere between 1,500 and 2,000 men, and if the individual successes have not been so striking as in some other districts, at least it can be claimed that the industry has afforded to those engaged in it a comfortable living in one of the most favoured climates in the world.

It is difficult to realise in these days, when the consumption of tomatoes in this country exceeds 100,000 tons per annum, that it is less than fifty years since the first glass-house for growing tomatoes for market, was put up in Worthing, while the tomato itself was regarded by the retailer as somewhat of a curiosity and was labelled by him " Love Apple ": indeed the fruit trade itself is of comparative modern development, as men who are still engaged in the business well remember.

Although mere names will not mean much to the majority of readers, it will interest many growers still living to mention that O'Bryrne, George Purser, and George Beer were among the pioneers of the glasshouse industry, and that parts of their

original houses are still in existence, although probably rather like the boy's pocket knife, which had had four new blades and two new handles. It was quickly realised that tomatoes, cucumbers and grapes could be grown to perfection under glass, and the pioneers were followed by the men who had gained a little experience as foremen and "hands" of the earlier growers.

The growth of the industry was rapid for twenty-five years. The houses most in favour for cucumbers were 16 ft. wide with 10 ft. rafters, and for tomatoes and grapes 20 ft. wide with 14 ft. rafters. While probably these sizes are most suitable for cucumber and grape growing, the Guernsey and Lea Valley growers consider the Worthing tomato houses to be much too small.

The popular south coast resorts have developed greatly during the past twenty years, and one would think that the fruit-growing industry would have expanded to a commensurate degree. The demand for tomatoes, cucumbers and grapes has enormously increased all over the country during the same period, but the demand has been supplied by the Lea Valley, the Channel Islands, and by Holland and Belgium, while the development of the Worthing district has been slow. At one time an easy first, Worthing now has to take third place to Guernsey and the Lea Valley.

It is worth while to compare the conditions ruling in the three districts in order to ascertain, if possible, the reason for Worthing's failure to advance as rapidly as other districts. The chief factors are cost of land, quality of land, climate and transport.

In the matter of cost, land in the Channel Islands costs more than in the Worthing district, which in its turn is much more expensive than the Lea Valley; for quality, land at Worthing is at least the equal of either of the other districts, and is almost certainly superior to the Lea Valley. So far as climate is concerned, Guernsey has an advantage over Worthing for earliness, while in this respect the Lea Valley is a very bad third. Earliness, however, is not the only factor: the Channel Islands are exposed to the full force of the Atlantic south-westerly gales, and growers are compelled to erect much heavier, stronger, and therefore more expensive, structures than their competitors on the mainland. Worthing is also exposed to the wind, and, while growers can build much cheaper than Guernseymen, they are compelled to build considerably heavier than the Lea Valley men.

Transport.—It is when transport is considered that one realises the advantages the Lea Valley growers have over those

of Worthing and the Channel Islands. The North London men gather their crop in the morning, load it on motor lorries at the packing sheds, whence it is taken by road to Covent Garden in less than two hours. Worthing is sixty miles from Covent Garden, and, although three attempts have been made to establish a motor-lorry service, they have all failed to compete successfully with the railway. The Worthing men do, however, pack in the morning and load the fruit train which leaves Worthing station at 12.30 mid-day, the produce arriving at Covent Garden between 4 and 5 in the afternoon. In the matter of transport the Guernseymen are at an even greater disadvantage; the G.W.R. and the L. and S.W.R. give an excellent service of both passenger and cargo boats, but, even so, the produce does not reach Covent Garden until the morning of the second day after despatch.

The difficulty of transport is a real one, but it is not sufficient to explain Worthing's recent slow progress.

The Worthing Glass-Houses.—The lay-out of the Worthing nurseries is faulty and uneconomical. For the most part the houses are small, and they are scattered and heated by a multiplicity of small boilers set in an equally large number of stokeholds, awkwardly placed and difficult of access. The Worthing pioneer, and, unfortunately, his successor of to-day, thought in terms of houses; the Lea Valley man, on the other hand, has had the experience of earlier growers to build upon, and has always thought in terms of acres. While the Worthing grower has thought of putting up houses in which to force stuff, the Lea Valley man has conceived the idea of covering in acres of ground with glass, in order to grow produce under artificial conditions. His lighter and therefore cheaper structures, involving less capital outlay, and the large saving effected in transport, have enabled him to produce at a lower cost than either of his principal competitors.

Crops.—In the matter of packing great strides have been made. It seems almost incredible in these days, when "trunks" are chiefly used for packing chrysanthemums, that at one time the favourite package for cut bloom was the 1s. cross-handle basket. There are men still engaged in packing at Worthing who used to pack chrysanthemums in the cross-handles The cultivation of the chrysanthemum is carried on extensively in the district, the mid-season and late varieties being "lifted" to follow cucumbers, tomatoes, and grapes, which with the chrysanthemums form the leading crops grown locally. Mush-

rooms and carnations are also specialised in by a few firms with much more than a local reputation. Early beans and forced strawberries are also important crops, although Worthing no longer maintains its reputation for the latter.

Worthing tomatoes have a great reputation, but Covent Garden regards Worthing grapes as of more importance, and the early Hambros, which have long been a speciality of the district, are eagerly sought after by the commission salesmen for distribution all over the country. In this domain Worthing has advantages which even now are not fully realised; climatic conditions rule the Lea Valley right out, while both the Guernsey and Belgian growers have transport difficulties to contend with, which in the case of grapes are greater than with tomatoes. While it is true that lightness of crop in the very early houses makes their production a doubtful economic success, it is nevertheless a fact that both Hambros and Muscats grown for marketing before the outdoor strawberry crop, come less into competition with supplies from other centres, and therefore realise more satisfactory returns than produce marketed later in the year. It is by taking advantage of their favourable climate that the Worthing men can continue to achieve success. Early tomatoes, beans, Hambros, Muscats and cucumbers will enable them to compete with other sources of supply, and, fortunately, nothing can take away from them their climatic advantage.

Cucumbers for Export.—Before the war Worthing did a considerable export business with Germany in winter cucumbers, and, practically had a monopoly of the business; as the cost of carriage beat the Guernseymen, who had to give up growing cucumbers, while the Lea Valley is too cold to compete with Worthing during the winter.

Recent Developments.—In 1921 there has been a development of building in the district, and, as the construction of the new places is on the lines of the most successful Lea Valley establishments, it will be interesting to watch the progress made in these up-to-date nurseries.

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SUGAR BEET GROWING IN HOLLAND AND BELGIUM.

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THE writer has spent several weeks in the Low Countries making a close study of the methods adopted there in the cultivation of sugar beet, and an attempt has been made in the following article to deal with some of the points that may be of service to British growers.

Soil.—Though the sugar beet will grow well in most soils, it does best on the medium and more friable soils. In Belgium and Holland it is grown on soils which have the texture of fine and coarse silts. In the province of Zeeland, *e.g.*, the soil is alluvial and contains a high percentage of calcium carbonate, while in North Brabant the soil is of a distinctly sandy character. Land which produces good crops of mangolds does not necessarily produce good crops of beet, so that farmers should choose the site for cultivation with care, and preference should be given to the lighter portions of the farm.

Careful consideration should be given to the drainage of the land. for land which "lies wet" is in every sense unsatisfactory. In Holland great stress is laid upon the advantages of "thorough" drainage, but many farmers adopt a system of open surface drains. These are 18 inches deep, and are placed from 9 to 25 feet apart according to the texture of the soil, with outlets into a main drain 2 feet 6 inches in depth. Examination of lands so drained during the wet months of the year showed that all surplus water was effectively removed.

Rainfall.—This is an important factor in the cultivation of the beet crop. In Holland it is stated that the best results are obtained when there is plenty of rain during the late spring and early summer to enable the seeds to germinate, and the young plants to make quick growth, followed, when the roots are well formed, by dry conditions for the maturing of the plants and the formation of a high sugar content. This fact has been established also in the laboratories of the sugar factories. Not only is the sugar content higher in a dry summer, but when once the plants have come well away in the spring a dry period does not have an adverse effect on the weight of the crop. In the dry season of 1921, where the beet was planted early, as in Zeeland, the weight of the crop was 20 per cent. above the average, but late planting in parts of Belgium resulted in many cases in great

loss. This emphasises the importance of rainfall during germination and until the plants have formed a well-developed root system.

Place in Rotation.—The beet crop is normally taken after a straw crop, and would in England occupy the place now taken by roots in the rotation. For long there has been dissatisfaction among farmers with the root crop on account of the high cost of production and the relatively low return. Whether sugar beet will assist the farmer in this matter is still a subject for experiment, but it can conceivably take the place of part of the roots now grown, with some financial benefit. The cleaning of the land is as easy under a crop of beet as under swedes or mangolds, and is of just as much importance, so that its introduction would cause no disturbance of present practice.

Tillage.—The land requires very thorough tillage for this crop, and farmers are particularly careful that the operations are carried out so that drilling may be commenced as early in April as the weather will pemit. The sequence of operations adopted in Holland and Belgium is:—

Autumn.	2 ploughings and thorough cleaning.
Spring.	Manuring.
	Cultivation.
	Rolling.
	2 harrowings.
	Manuring.
	Drilling.
	Light harrowing.
	Rolling.

The two ploughings are carried out with an interval of at least a month between, and the land lies in furrow during the winter. The sub-soiling plough is used once during the rotation, usually when the clover land is being ploughed up.

Manuring.—It is freely recognised that different types of land have different manurial needs, so that hard and fast rules for manuring the beet crop cannot be laid down, but the matter is so important that it should be the subject of careful thought. It must be remembered that the beet responds well to heavy manuring.

The application of farmyard manure to beet land is not favoured in Holland, but a dressing of 10 tons to the acre is frequently given in Belgium. Dutch farmers prefer to give 20 tons of farmyard manure per acre to the land at such a place in the rotation that one or preferably two crops have been removed before the beet crop is planted. They affirm that the highest sugar percentages follow such a practice, and that maturing of the crop is more regular.

Mineral manures are very freely used, and successful growers of beet in the Low Countries give the following applications as suitable for the production of good returns in their respective districts :—

	Superphosphate *or* *Basic slag.* cwt. per acre.	*Kainit* *or* *Sylvinit.* cwt. per acre.	*Ammonium sulphate* *or* *Nitrate of Soda.* cwt. per acre.
Holland : Zeeland ...	5	—	2—4
Belgium : Velm ...	8	8	4

The applications used in Zeeland have been established as the result of controlled experimental work. In these experiments, kainit, at the rate of 3 cwt. per acre, was added to the manures given above, but since this application did not in any way improve the crop, and since the alluvial soil contains sufficient available potash, the practice of using kainit was discontinued in that part of the country. In North Brabant, however, and in Belgium, applications of potash manures are necessary.

The amounts of mineral manures applied in the Belgian district quoted above illustrate the variation of manurial needs according to the type of soil. The applications are higher than those given by farmers in other parts of the country, but it must be admitted that during this dry year such heavy manuring proved advantageous, for the crops there were both early and heavy. A much more general Belgian manuring is :—

10 tons of farmyard manure, applied early in autumn.
5 cwt. superphosphate or basic slag.
3 cwt. kainit or sylvinit.
3 cwt. ammonium sulphate or nitrate of soda.

When the dressings given above are compared with those adopted in England, the outstanding differences are in the amounts of superphosphate and nitrogenous manures. The large dressing of nitrate of soda or of sulphate of ammonia has proved its usefulness. The nitrogen forces the plant into early growth and prevents any check throughout the growing season, but this continued growth does not, as one might expect, delay the time of harvesting. From the results observed in the Low Countries, it appears that an increase in the amount of quick acting nitrogenous manures might be of advantage in England.

The farmyard manure should be applied and spread before the second ploughing in the autumn. The superphosphate or slag, and the kainit, are sown at the end of December or during the early part of January whenever the weather is favourable. The nitrogenous manure is sown in doses, the first just before

drilling and the second immediately after singling. The application of the manures in this way should give the best results, for it allows time for the necessary chemical actions in the soil, and by the time the seeds have germinated the plant food has become available. Continental farmers consider that the early sowing of mineral manures is not associated with loss.

Seeds and Sowing.—Many varieties of sugar beet are available to the grower, but, as a rule, seed that is foreign to the district is planted. Before 1911 most of the seed that was used in both Holland and Belgium was obtained from French growers, but important factors sent the trade into German hands. The German merchants sold their seed with guarantees of minimum germinating capacity, true variety, and minimum sugar percentage, and these guarantees served to capture the trade.

Formerly each farmer cultivated that variety which he fancied most, but recently a different system has been instituted. The farmer purchases his seed from the factory that buys his roots, and this ensures that each factory is dealing with only those varieties which it can most satisfactorily handle, as well as assuring it of a definite supply of roots of uniform character and variety. At the moment great care is needed in the importation of Continental seed, for there is a general complaint among the farmers of the Low Countries of seed adulteration.

Before sowing, the Dutch farmers of Zeeland treat the seed with a 2 per cent. solution of copper sulphate. It is thoroughly wetted on a stone floor, piled in heaps, and covered with a cloth soaked in the solution. It is allowed to remain for 12 or 15 hours, and then spread and air-dried. This treatment, it is considered, reduces the loss of seed through attacks by the wireworm.

The drilling of the seed begins as early in April as weather permits, and is usually completed about the middle of May. About 18 or 20 lb. of seed per acre is sown in rows from 14 to 16 inches apart. It is never sown more than $\frac{3}{4}$ inch in depth, and if the ground be damp $\frac{1}{2}$ inch deep is quite sufficient.

Intertillage.—The intertillage of the beet crop differs in nowise from that given to the root crop in Britain. Too much stress cannot be laid upon the necessity of keeping the crop clean, for on this its success is largely dependent. When four leaves appear the singling is commenced, and the plants are left 14 inches apart in the rows. Immediately singling is completed the second dose of nitrogenous manure is applied, and this serves to prevent that check to the growth of the plant which often follows rough usage.

Harvesting.—This begins at the end of September and continues till mid-November. Slight frosts will not harm the roots, and it is better to delay the lifting till the ground is really needed for preparation for the next crop. The late lifting allows the action that follows the application of large dressings of potash

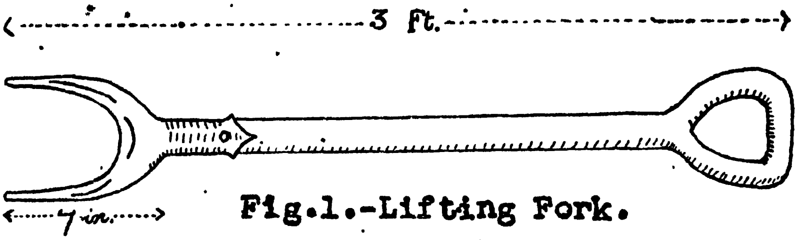

Fig. 1.—Lifting Fork.

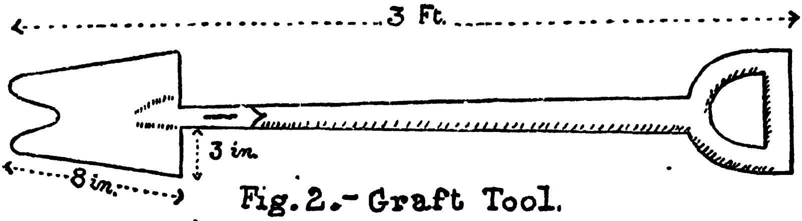

Fig. 2.—Graft Tool.

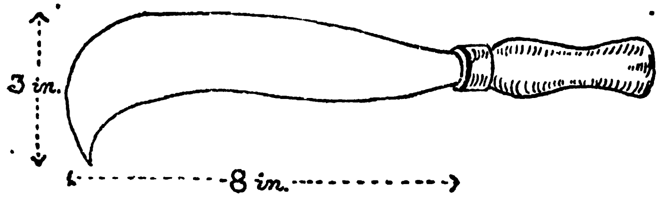

Fig. 3.—Topping Knife.

manures to become completed, and larger quantities of sugar are formed and stored in the roots. The crop can be ploughed out with a special light plough, or a satisfactory substitute for this can be made by removing the mould boards from a common single furrow-plough and so adjusting the wheels that the chisel-pointed share cuts to a depth of 9 or 10 inches. This method is not recommended except where the farmer can personally supervise the work, for it increases the possibility of damage to the roots.

The practice usually adopted in Holland and Belgium is lifting by hand. When the soil is dry and friable, the labourer uses a short, stout two-pronged fork as shown in Fig. 1. This fork is about 7 inches long, with the prongs not more than 4 inches

apart. Should the conditions be wet, the fork is replaced by a light graft-like tool illustrated in Fig. 2. Either of these tools will enable the workman to dig or lever the beet from the soil with ease. As the beets are lifted they are placed in rows, with leaves all pointing in one direction. This is important, since it saves labour in topping.

Topping.—Each labourer carries in his belt a topping knife similar to a butcher's chopper weighing about 1 lb. (Fig. 3.).

Having lifted a row of beet, he returns, and, picking up each beet by means of the curved point of his knife, he tops it by a quick straight cut, the cut being made at the level of the lowest leaf scar. The roots are then thrown into heaps.

The topping of the beet in the correct position is a matter that requires strict supervision. If it is topped too near the leaves, the farmer loses part of the crown, which contains valuable cattle food, yet for the extra weight in the roots he receives no credit from the factory manager, for the crown is of little value for sugar extraction. When returning for his lifting tool, the labourer covers the heaps of roots with leaves to prevent drying, or damage by severe frosts before carting is possible.

The lifting, topping, and loading into carts, is usually done by piecework, and gangs of men go from farm to farm for this alone. In loading the beets into the carts, they use a concave five-pronged fork, the points of each prong being enlarged and rounded to prevent the penetration of the roots

Mechanical Harvesting—Mechanical lifting is carried out only where the beets are grown on a large scale. Various machines have been devised to do the work quickly and simply. At a demonstration at Gembloux, in Belgium, in September, two machines carried out the work of topping and lifting expeditiously and efficiently. A Belgian machine did the work in two operations. Several rows were first topped by a separate machine drawn by horses, the tops and crowns being mechanically raked into heaps for carting. This machine was followed by a digger drawn by a light tractor.. A machine sold by M. Guichard, of Lieusaint, France, is a combined topper and lifter light enough to be drawn by three horses, which will top and lift 2½ acres of beet in a day of 8 hours.

The topper consists of a drum capable of vertical movement, and directly in the rear of this a knife which beheads the beet. When the drum comes into contact with the beet tops, these are drawn in and the knife is forced against the crown of the plant. The severed tops are deposited in rows on one side of the

machine. With this machine the tops are macerated, and will serve best as green manure. Behind the topper is the share which lifts the beets from the soil without damaging them in any way. A set of forks, similar to those in the Martin potato digger, turns at some speed behind the share, and catching the roots, throws them into a large drum, where the adhering earth is removed. The beets are carried by cross bars to the top of the drum and dropped into a hopper which will hold about 140 lb. This hopper can be emptied by the machine mechanic quickly and easily, and it leaves, every 40 or 80 yards, a heap of beets that can be readily removed by the following carts. Harvesting of beets with machines of this type is similar to, but much less expensive than, harvesting potatoes on a large scale.

Use of Tops.—The farmer must decide for himself what will be done with the leaves and crowns, but there are several possibilities. They make excellent green manure and can be profitably ploughed in. They can be fed green to cattle, folded with sheep, or used for silage. They are always marketable, though to sell them is inadvisable, for they seldom fetch a price at all equivalent to their value; for instance the price last season has been as low as £1 10s. 0d. per hectare, *i.e.*, about 12s. 6d. per acre. Leaves recently analysed in Holland were found to contain:—Nitrogen 0.56 per cent, Phosphates 0.24 per cent., Potash 0.8 per cent. This will show that they contain a large percentage of the elements necessary for plant food, and if the Unit Values are taken at, nitrogen 17s., potash 4s. 10d., and phosphoric acid 3s., the value of a ton of tops and crowns as green manure would be approximately 14s.

As a cattle food, Kellner, in the "Scientific Feeding of Animals," gives the following figures:—

	Tops and Crowns of Beet.		
	Wet.	*Siloed.*	*Dry*
Starch equivalent ...	7·2	9·5	27 0

A Dutch Commission of experts placed their feeding value somewhat higher than this.* It can be concluded that when fresh these products have a higher feeding value than mangolds, and when dry the feeding value is about equal to that of clover hay. Therefore the preservation of these by-products is a matter of great importance to the farmer. Continental farmers praise the tops as a food for milch cows, but care should be taken to see that they are fed clean and fresh, for without judicious watching they are liable to cause "scour" in the early part of the season.

* See this *Journal*, Vol. xxii, p. 750, November, 1915.

IMPROVEMENT OF GRASSLAND IN CORNWALL.

SOME interesting results have been obtained from a series of grassland experiments conducted by the Agricultural Committee of the Cornwall County Council. At one centre at Meudon, Mawnan, two fields of temporary pasture were placed at the disposal of the Committee. In Field A., the herbage of which was very thin and poor, five one-acre plots were set out on one half of the field and treated in the winter of 1920-21 as follows:—

Per acre.

Plot 1.—Control. No manure.
,, 2.—1,120 lb. 20 per cent. Basic Slag.
,, 3.—448 lb. 30 per cent. Superphosphate.
,, 4.—448 lb. 30 per cent. Superphosphate and 168 lb. Sulphate of Ammonia.
,, 5.—As No. 4, with 112 lb. Muriate of Potash.

The plots were cross-dressed with lime as follows (per acre):—
(*a*) 4 tons Sea Shell Sand (containing 4 cwt. Lime per ton).
(*b*) 2 tons Ground Limestone.
(*c*) 10 cwt. Ground Lime.
(*d*) No Lime.

At inspections in November, 1921, and March, 1922, the basic slag plot proved to be the best of the series. There was a close bottom of White Clover, and the whole was closely grazed, while there was an absence of inferior grasses. The herbage on the sulphate of ammonia plot (No. 4) was rougher and coarser, with less White Clover, and was not closely grazed. The complete manure plot (No. 5) was almost equal to the slag plot. There was a great contrast between the above plots and the other half of the field which had received farmyard manure only. When the hay crop was weighed green in June, the best results were obtained from slag after lime ($3\frac{6}{7}$ tons per acre), slag after sand ($3\frac{5}{7}$ tons per acre), superphosphate after sand ($3\frac{4}{7}$ tons), superphosphate and sulphate of ammonia after limestone (5 tons per acre). These should be compared with the yield of $1\frac{3}{7}$ tons per acre from the control plot. It is interesting to note that the sea shell sand as a dressing for grassland was at least equal to other forms of lime. Farmers living within a few miles of the coast might well consider the advisability of using lime in this form.

On Field B. the pasture had been laid down two years before the experiment commenced (spring, 1921), and it was then in a

poor condition. The treatment was designed to ascertain whether such a pasture could be so improved as to obviate the necessity of breaking it up for a few years. The field was divided into six one-acre plots and treated with (1) Superphosphate, (2) Superphosphate, Sulphate of Ammonia and Muriate of Potash, (3) Superphosphate and Muriate of Potash, (4) No manure, (5) 33 per cent. solution of Sulphate of Ammonia, and (6) Farmyard Manure.

On $2\frac{1}{2}$ acres across the plots, one half of which had received lime and the other half had not, a renovating mixture consisting of 2 lb. Single-cut Cowgrass, 1 lb. White Clover, 1 lb. Alsike Clover, 1 lb. Timothy, 1 lb. Rough-stalked Meadow-grass, 8 lb. Perennial Rye-grass per acre, was sown in April, 1921, after the surface had been thoroughly harrowed. The field was inspected in November, and the following report made: "The limed portion showed great improvement and was more evenly grazed. The effect of the renovating mixture was excellent, there was a good 'take' of clover, and such weeds as *Prunella* and silver leaf, which were very conspicuous before treatment, were only to be seen in isolated patches. The plots to which superphosphate and potash were applied were all greatly improved, particularly the potash ones."

The success of this experiment in renovating a very poor thin pasture is striking, and should encourage other farmers to try the effect of a good harrowing with a toothed harrow, followed by the application of a few pounds of suitable mixture per acre, rolled in and dressed with superphosphate and potash.

At another centre at Trebilcock, Roche, three experiments were conducted. In Field A. liming was followed by a "seeds" mixture for temporary pasture. The lime applied was at the same rate as in Field A. of the Mawnan centre (ground lime, ground limestone and sea sand). The field was "seeded out" on dredge corn in 1921, four separate mixtures being sown on one-acre plots. A great difference was seen in October, 1921, between the limed and unlimed portion of the field, the sea sand plot especially showing up remarkably well.

Field B., an old rough and coarse pasture, was divided into four one-acre plots and treated with artificials. The plots were then cross-dressed with lime in the three previously mentioned forms. In October, 1921, and again in March, 1922, a great improvement on all the manured plots could be seen, but the most noticeable was on Plot 4, which had received Superphosphate, Sulphate of Ammonia and Muriate of Potash.

Since these notes were written, Mr. W. Borlase, the Agricultural Organiser, has paid a visit to the plots, and states that the improvement noticed at Meudon and also at Roche continues. At the latter centre the quality of the pasture on the part of the field devoted to the experiment is much superior to that on the part seeded and manured by the farmer.

The results of all these experiments are very striking, in spite of the unfavourable season, and they cannot but be useful to the farmers of the district. They seem to emphasise the fact that much pasture is starving for want of either lime or phosphates, in many cases both.

NOTES ON MANURES FOR APRIL.

E. J. RUSSELL, D.Sc., F.R.S.,
Rothamsted Experimental Station, Harpenden.

Can Lime be mixed with Sulphate of Ammonia?—Several correspondents have asked whether it would be safe to mix lime or calcium carbonate with sulphate of ammonia and superphosphate in order to counteract the tendency of these substances to induce acidity in the soil. This plan cannot be recommended; it might answer if every condition were favourable, but under ordinary circumstances it is attended with too much risk. Serious loss of ammonia would arise if the mixture became damp or if it were not speedily and sufficiently covered with soil, and there would be danger of serious reversion of the phosphates. It is far better to put on the two substances separately—the lime or calcium carbonate in the autumn or early winter; or, at the present time, to land which is due to come into roots or clover leys; and the sulphate of ammonia for potatoes, barley, etc., and as top dressing for winter corn crops.

Potassic Fertilisers on Pastures: Under what conditions should they be used?—It has been shown that potassic fertilisers give good results on pastures only on certain peaty soils. Professor Somerville quotes an instance in the county of Dumfries of a pasture on 10 ft. of peat where the addition of 8 cwt. of kainit per acre to 10 cwt. slag markedly increased the yield of mutton during the next 7 years and left a substantial profit. Apart from these peat soils it is not usually found that potash is an advantage; neither in the English nor in the Scottish trials did it give more than slight increases and usually not profitable

ones. This remark of course does not apply to hay land, where potash frequently gives good results.

Lime on Pastures: Is it any use?—Considerable diversity of opinion was expressed at the meeting of the Farmers' Club, where Professor Somerville read his paper on the Improvement of Poor Pasture, as to whether lime is of value for this purpose. There is much evidence that lime *alone* will not effect a profitable improvement of such land, but this is only in accordance with old farming experience.

"Lime, and lime without manure,
Will make both land and farmer poor."

It is not surprising therefore that neither at Cockle Park, nor in Northamptonshire and Hampshire, did lime alone give any useful result. Indeed, at Cockle Park the continued use of a small dressing of lime at three years intervals appears now to be doing positive harm.

The case, however, is different when lime is used *in conjunction with slag or cake*, and cases were quoted in the discussion where this combination had given useful results.

It is often stated that lime in the slag should suffice for the purpose of pasture land, but as a matter of fact only about 2 per cent. of free lime is usually present, so that a dressing of 10 cwt. of slag per acre would supply only 22½ lb. of lime. While this small quantity would do something, one could not expect it to do much. There is, however, often 35 per cent. or more of combined lime, which might prove useful.

In a number of the Royal Agricultural Society's trials lime proved of value on pasture land, but it is not as certain in its effects as slag, and farmers should try a small scale experiment before embarking on any large expenditure. On hay land lime may be more effective.

Organic Manures v. Artificials.—This question was discussed at some length in a paper in this *Journal* (Vol. XXVI, p. 228, 1920), where it was shown that the experiments up to that date indicated no superiority of organic manures (guano, rape dust, etc.) over a cheaper mixture of artificials, and recent experiments confirm this conclusion. The system of manuring on the Little Hoos field at Rothamsted was somewhat altered in 1919 so as to allow of a strict comparison between artificials and organic manures without detracting from the original scheme of the experiment, and the result has been to show the value of the artificials.

The crop yields are:—

	Barley, 1919. Grain bush.	Barley, 1919. Straw cwt.	Swedes, 1920. Roots tons.	Barley, 1921. Grain bush.	Barley, 1921. Straw cwt.
Complete artificials only:—					
including Basic Slag ...	31·2	17·4	15·8	34·1	20·1
„ Superphosphate	23·9	16·3	16·3	33·5	17·8
Guano	24·3	17·0	14·4	27·9	17·1
Rape dust	22·4	13·5	13·3	36·1	17·3
Shoddy	23·3	14·5	11·9	30·8	16·0
Bone meal	23·2	14·6	8·6	24·1	14·1

In each case the dressing contains 40 lb. of nitrogen, 100 lb. of calcium phosphate and 50 lb. of potash per acre. Each plot was supplied with as much of its particular manure as possible (shoddy, guano, etc.) without exceeding the receipt in any of the three rationed ingredients. Any deficit in any one of these three was made good by adding the necessary quantity of sulphate of ammonia, superphosphate or sulphate of potash.

Manuring for a Rotation: How long will it last?—The manures ordinarily in use do not deteriorate in the soil but they suffer loss in two ways: (*a*) all fertilisers are taken up by the crop and bodily removed from the soil; (*b*) the nitrogenous manures are liable to be washed out from the soil, but the potash and phosphate are not. It has been shown on an earlier occasion that a moderate sized cereal crop removes from the soil the equivalent of 3 cwt. of sulphate of ammonia, 1½ cwt. of superphosphate and ¾ cwt. of sulphate of potash per acre; a 12-ton crop of potatoes removes the equivalent of 4 cwt. sulphate of ammonia, 8 cwt. of superphosphate and 2½ cwt. of sulphate of potash; and a 30-ton mangold crop the equivalent of 5 cwt. of sulphate of ammonia, 3 cwt. of superphosphate and 5 cwt. of sulphate of potash. It is only when the total dressing of dung and artificials exceeds these amounts that any effect can be expected in the second year.

Bone Meal and Dissolved Bones: Are they useful on Grass Land?—In the past great results were obtained by the use of bone manures on grass land in Cheshire, and a considerable reputation was gained for these substances. It is, however, doubtful whether they really deserve to stand very high in esteem for this purpose. In the Cockle Park experiments they certainly were not as useful as slag on grazing land, as they did not encourage the white clover to anything like the same extent. A number of trials organised by the Royal Agricultural Society and reported by Dr. J. A. Voelcker and Professor Carruthers in 1900 (Journ. Royal Agric. Soc., 1900, Vol. LXI. 116) were quite unfavourable.

NOTES ON FEEDING STUFFS FOR APRIL.

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Ministry of Agriculture and Fisheries.

Vitamines in Feeding Stuffs.—Several correspondents have written within the last few weeks asking for information regarding certain proprietary feeding stuffs which are sold expressly on the guarantee that they are peculiarly rich in vitamines. It appears evident from these inquiries that the farming community would welcome a few notes as to the value of these "vitamines" and the extent to which they are normally present in ordinary farm foods.

"Vitamines" are substances which, although present in small amount in feeding stuffs, exercise a profound effect on the health and well-being of growing and adult animals. Their composition is at present unknown, and their presence in any food or liquid can at present only be detected by the effect they produce on animals when included in a diet known to be free from vitamines.

The origin of the discovery of these mysterious "accessory food factors" forms an interesting story. Some years ago Prof. F. Gowland Hopkins was conducting feeding experiments on rats, in which the substances used consisted of chemically pure protein, fat and carbohydrate, together with ash constituents necessary for normal growth. This constituted in our then state of knowledge a complete diet, but the curious fact was established that, although these rats digested their food satisfactorily, not one of them grew, and if kept on this diet for a sufficiently long time the rats collapsed and died.

On establishing this fact, it was decided to ascertain the result of adding a few drops of raw milk in the diet, with the astonishing result that the rats grew normally. There was evidently some substance present in the raw milk which was essential to normal growth, and without which growth could not take place. This growth-promoting substance was called a "vitamine." Contemporaneous research on the diseases of scurvy and beri-beri showed that these disease conditions were caused by the absence in the diet of some substances present in small amounts in certain fresh foods. All these substances are grouped under the term "vitamines," of which three are recognised, called respectively Fat Soluble A, Water Soluble B,

and Water Soluble C. Most of the common foods have been tested for the presence or absence of these factors and a list compiled which has been published by the Medical Research Committee, and extracts from which appeared in a recent number of this *Journal*.* The chief broad statements that can be safely made are :—(1) Foods in which accessory food-factors

DESCRIPTION.	Price per Qr. s.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv. s.	Price per lb. Starch Equiv. d.
Wheat, British	57/-	504	12 13	1 0	11 13	71·6	3/3	1·74
Barley, English Feeding	37/-	100	10 7	0 18	9 9	71	2/8	1·43
" Canadian "	33/6	400	9 8	0 18	8 10	71	2/6	1·34
Oats, English White "	36/-	336	12 0	0 19	11 1	59·5	3/9	2·01
" " Black & Grey	32/6	336	10 17	0 19	9 18	59·5	3/4	1·78
" Canadian	33/6	320	11 14	0 19	10 15	59·5	3/7	1·92
" Argentine	31/3	320	10 19	0 19	10 0	59·5	3/4	1·73
Maize, "	45/6	480	10 12	0 17	9 16	81	2/5	1·30
" South African	38/6	480	9 0	0 17	8 3	81	2/-	1 07
Beans, English Winter	65/-†	532	13 14†	1 15	11 19	67	3/7	1·92
" Rangoon	—	-	9 0	1 15	7 5	67	2/2	1·16
Buckwheat, Manchurian	59/-	392	16 17	1 6	16 11	53·4	6/2	3·30
Millers' offals—								
Bran	—		9 0	1 16	7 4	45	3/2	1·70
Broad Bran	—	—	9 15	1 16	7 19	45	3/6	1·87
Fine middlings	—	—	9 10	1 7	8 3	72	2/3	1·20
Coarse middlings	—	—	9 5	1 7	7 18	64	2/6	1·34
Pollards (Imported)	—	—	8 0	1 15	6 5	60	2/2	1·16
Barley Meal	—	—	12 0	0 18	11 2	71	3/2	1·70
Maize "	—	—	8 17	0 17	8 0	81	2/-	1·07
" Germ Meal	—	—	9 15	1 5	8 10	85·3	2/-	1·07
" Gluten-feed	—	—	10 10	1 11	8 19	75·6	2/4	1·25
Locust Bean Meal	—	—	9 5	0 9	8 14	71·4	2/6	1·34
Bean Meal	—	—	14 0	1 15	12 5	67	3/8	1·96
Fish "	—	—	16 10	5 10	11 0	53	4/2	2·23
Linseed	—	—	20 15	1 16	18 19	119	3/2	1·70
" Cake, English (9% oil)	—	—	16 0	2 6	13 14	74	3/8	1·96
Cotton seed " English (5% oil)	—	—	9 7	2 6	7 1	42	3/4	1·78
" " Egyptian (5% oil)	—	—	9 2	2 6	6 16	42	3/3	1·74
" " decorticated (7% oil)	—	—	14 0†	3 11	10 9	71	2/11	1·56
Coconut Cake (6% oil)	—	—	9 10	1 19	7 11	73	2/1	1·12
Groundnut " (6% o) (undecorticated)	—	—	10 0	3 5	6 15	47	2/10	1·52
Palm kernel Cake (6% oil)	—	—	8 0†	1 9	6 11	75	1/9	0·94
" " Meal (2% oil)	—	—	7 0	1 9	5 11	71·3	1/6	0·80
Feeding Treacle	—	—	6 5	1 1	5 4	51	2/-	1·07
Brewers' grains, dried, ale	—	—	10 5	1 11	8 14	49	3/7	1·92
" " " porter	—	—	9 2	1 11	7 11	49	3/1	1·65
" " wet, ale	—	—	2 10	0 8	2 2	15	2/10	1·52
" " wet, porter	—	—	2 6	0 8	1 18	15	2/6	1·34
Malt culms	—	—	8 15	2 3	6 12	43	3/1	1·65

* Vol. XXVII, October, 1920, p. 666. † Prices at Liverpool.

FARM VALUES.	—	—	Value per Ton on Farm. £ s.	Manurial Value per Ton. £ s.	Food Value per Ton. £ s.	S.E. per 100 lbs.	Value per s.	Market Value per lb. S.E. d.
Potatoes	—	—	2 9	0 5	2 4	18	2/5	1·30
Swedes	—	—	1 0	0 3	0 17	7	2/5	1·30
Mangolds	—	—	0 17	0 4	0 13	6	2/5	1·30
Good Meadow Hay	—	—	6 9	0 18	5 11	31	3/7	1·92
Good Oat Straw	—	—	3 11	0 10	3 1	17	3/7	1·92
Good Clover Hay	—	—	6 19	1 4	5 15	32	3/7	1·92
Vetch and Oat Silage	—	—	2 10	0 8	2 2	14	3/0	1·61

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of February and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 9s. per ton. The food value per ton is therefore £8 11s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 3d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·21d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

are absent are all fats and oils of vegetable or plant origin, polished rice, tinned meats, and kilned oatmeal and peameal. (2) Fresh animal meat, green foods (particularly cabbage), milk, and root vegetables contain all three "vitamines." Peas, beans, and cereal grains, *after germination*, also contain these vitamines.

Oils of animal origin, particularly butter and codliver oil, are rich in Fat Soluble A (the absence of which causes rickets). Eggs, dried yeast, wheat germ, linseed and millet, are all rich in Water Soluble B (the absence of which causes diseases such as pellagra and beri-beri). Raw cabbage and fresh fruit juices are especially rich in the Water Soluble C vitamine (absence of which causes scurvy).

What is the bearing of these facts on the normal practice of feeding farm animals? In most cases farm animals get at some time or other fresh green foods, which are fairly rich in vitamines. In such cases the inference is obvious: there is no need to provide specially for the animal by supplying proprietary foods guaranteed rich in vitamines. The only case where there is perhaps a possibility of deficiency of vitamines is in the case of sty-fed pigs receiving cereal offals without any addition of green food. In such cases the writer always advocates the addition of a small amount of codliver oil to the diet.

One final point: the amount of vitamine needed is extremely small, and is likely to be provided in excess by any normal dietary.

Ants and Ant-hills.

ANT-HILLS in grass land are not only unsightly but they prevent the use of the mowing machine. To level and distribute ant-hills by hand labour is a tedious and costly proceeding. Ordinary zig-zag and chain harrows make little or no impression on them but a drag harrow behind a tractor does quite efficient work, levelling and distributing the soil evenly in one operation.

On sloping or uneven ground, where the use of a tractor would be difficult, a tractor paring-skim pulled by two horses will cut the hills flush with the ground, but a considerable amount of harrowing is afterwards necessary to disentangle the soil from the turf.

It must be remembered that the levelling of the ant-hill does not destroy the nest underground and there is always the risk of the ants getting to work again. To obviate this, it is advisable to apply some form of manure which will have the effect of encouraging a rapid growth of the grass. If it is possible to mow instead of grazing for two or three years, so much the better, as the ant does not seem to flourish in a heavy growth of grass and is not much met with in fields continually mown for hay.

How far ants may be considered to benefit the soil is a question which still awaits final solution. It is possible that some gratitude is owed to them for more than their proverbial example of industry. It is conceivable that they may serve a good purpose in promoting the aeration and drainage of the soil by their subterranean activities, and in bringing up the lower soil for distribution as a top-dressing. In a chalk country, the surface soil long denuded of lime may be benefited by the addition of the lime thrown up from their workings. At any rate, there is no doubt that the soil from ant-hills is sought after by gardeners for potting and for spreading round transplanted trees and shrubs.

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Goat-keeping.

THE Ministry of Agriculture has recently issued two leaflets on goat-keeping—Leaflet No. 306, The Goat as a Source of Milk, and No. 383, Hints on Goat-keeping.

The Ministry attaches importance to the development of goat-keeping in this country for economic reasons. There is undoubtedly a considerable quantity of waste vegetable material in rural and urban districts which could with very little trouble be converted into valuable human food by means of the goat. Moreover, there are many people living in more or less remote districts who find difficulty in obtaining adequate supplies

of fresh milk for domestic purposes, especially for feeding young children, for whom goat's milk is particularly suitable.

In several foreign countries where agriculture is a prosperous industry, goat-keeping is practised on a very considerable scale. In Holland, for instance, which is a highly cultivated country possessing large herds of valuable milch cows, there were in 1910, according to the official census figures, 224,231 goats. Similar conditions exist in Belgium, and it may be said that goat-keeping is considerably more common in most European countries than in this country, where, however, climatic and economic conditions are by no means unfavourable for goat-keeping.

The goat is, in fact, a hardy animal which thrives well in all European countries. A fairly good nanny goat should produce in one year from 70 to 100 gall. of rich milk at a very low cost, while a first-class milch goat will yield double as much and will probably cost no more to keep than one of poor quality.

It is not essential that goats should have access to grazing. They may be fed largely on cheap or waste greenstuff from the garden or allotment, and on hedge clippings and weeds such as dandelions, sow thistles, docks, young nettles, etc. They are therefore particularly suitable for farm labourers, small holders, allotment holders and cottagers. It is true that goats in milk require a little concentrated food and in the winter some hay, but for the rural dweller who is not able to keep a cow a good milking goat is a most valuable and economical animal, whose merits are at present not sufficiently appreciated.

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THE following experiment has been carried out by Mr. C. H. Oldham, one of the Ministry's inspectors :—

Tarring Posts Infected with Silver Leaf Disease.

Most growers of fruit, both commercial and private, have during the past few years taken an interest in the methods of prevention of the Silver Leaf Disease, and to many the life-history of the causal fungus (*Stereum purpureum*) is now known.

At present it is an undoubted fact that the plum is more susceptible to attack than other types of fruit trees, and in commercial orchards, the varieties Victoria and Czar appear much more liable than others to infection.

While experiments in many directions are being conducted to find some practical method of prevention or cure, up till now it appears that the best method to prevent the spread of the disease is to remove infected wood as early as possible after the appear-

ance of silvered foliage. By this means it is possible to save the life of the tree, providing that the silvered branches are cut back to clean wood.

The fungus causing Silver Leaf spreads in the wood by means of mycelium, which may be traced by the dark stains in the wood. If infected wood—even though in a living condition —is not removed beyond these dark stains the fungus is capable of spreading to other portions of the tree, and if allowed to go on unchecked will ultimately kill the host.

A dead plum or other fruit tree killed by Silver Leaf Disease is a source of danger to any other specimens in the orchard, for the fungus then produces fructifications bearing spores which are capable, after being distributed by wind or other agencies, of infecting healthy trees, providing suitable weather conditions prevail, entrance being afforded by means of cracks in the bark, wounds, or unprotected pruned surfaces.

Since the introduction of the Silver Leaf Order of 1919 especially the cutting out of infected wood has been practised by fruit growers, and there has been a tendency occasionally to use the infected wood for posts, either to stop gaps in the fence around the orchard itself, or elsewhere on the holding or farm. Unfortunately, however, many growers are under the impression that if such wood is painted with tar the fungus will be rendered incapable of producing the incrustations or bracket shaped bodies bearing the spores.

The Ministry therefore conducted experiments to ascertain whether tar really had the power to prevent the fructifications of *Stereum purpureum* from appearing on infected wood. A preliminary trial was made in an orchard formerly severely attacked by Silver Leaf, belonging to Mr. T. Hatley, J.P., of West End, near Southampton. It was particularly desirable that the experiment should be conducted in the district, since the amount of disease present in the area was considerable, and many growers had suffered heavy losses owing to the spread of the disease.

On 11th November, 1920, three posts were selected for the experiment, which were known to be infected and had been sawn from plum trees of the Victoria variety.

The posts were placed in the following order:—

Post No. 1, Bark removed.
Post No. 2, Bark not removed.
Post No. 3, Control.

Owing to bad weather it was impractical to paint with tar until

18th November, 1920, but on this date posts Nos. 1 and 2 were given a good coating. On 20th December, 1920, the site was again visited, and it was observed that on post No. 3, which was used for control purposes the fructifications of *S. purpureum* were appearing, but on the tarred posts, Nos. 1 and 2, none was present. Tar, when in possession of its antiseptic properties, has, therefore, apparently the power to retard the development of the fructification.

The posts have been kept under observation at various intervals and a visit was again paid on 27th January, 1922, when it was noticed that on post No. 2 the fructifications of the disease had developed. It is clear therefore that if growers tar over wood cut from Silver Leaf diseased trees without removing the bark it does not prevent the production of the reproductive bodies of stereum.

It is worth noting that the fructifications did not appear until fifteen months after the post was painted. There is, however, some ground for believing that but for the continued dry period experienced last season these reproductive bodies would have appeared earlier.

Further observations are needed to prove whether tarring after removal of the bark will prevent the production of the fungus. Some authorities are doubtful if it will have a lasting effect, but since for the commercial grower it is hardly practicable to remove bark when any quantity of posts are required, this point is not of much economic value.

The result of this experiment illustrates the importance of the destruction of wood infected with the disease. Such material should not be used for posts under any circumstances, but could be used as fuel for domestic purposes, immediately after pruning, or collected in a heap and burned together with other prunings from the orchard.

* * * * * *

A Metal Plant Bucket.

A DESCRIPTION has been received from one of the Ministry's Inspectors of a metal plant bucket intended for use in place of the ordinary flower pot. The inventor constantly noticed that certain plants appeared to give better results when grown in old pails and buckets. After experiments extending over several years he produced a bucket which has now been tested in the production of crops on a commercial basis for over six years with apparently satisfactory results. The bucket, which is approximately 12 in. in height and 9 in. in diameter, is constructed

of pure zinc and is practically indestructible. A special feature is a false or moveable bottom with a single hole underneath for drainage.

The chief reason for the superiority of the bucket over clay pots is that considerably less watering is required. This makes for the maintenance of a more equable root temperature especially during periods of rapid evaporation. The saving of labour in watering is also considerable. Its advantage over clay pots in the matter of breakage is obvious.

The disadvantage of the appliance is its cost. It is patented and at the moment is manufactured in a spasmodic way without special plant at a cost of 2s. 10d. each. The patentee has found, however, that while it is extremely desirable to cheapen the bucket, the present cost is not prohibitive for the purpose for which it is used.

One of the most striking purposes for which the plant bucket is employed at Hassocks is the cultivation of high quality dessert pears under glass. The method followed is very simple. Cordon pear trees of choice dessert varieties are propagated on the premises and permitted to attain a bearing age outside. They are then lifted, planted in the plant bucket and brought into the houses. At the conclusion of the fruiting period the trees are taken outside again, the culture, once the trees are in the buckets, being that usually accorded to orchard house trees. The writer inspected a house of pears grown in this manner and was considerably impressed with their appearance. A crop of from one dozen to two dozen fruits is allowed to each tree and these are matured without any trouble. No artificial heat is employed and pests are not severe, the few caterpillars which appear in the spring being removed by hand-picking.

Tomatoes are also successfully grown in the bucket and this crop affords a satisfactory basis for comparison with flower pot culture. In every case the buckets give much better results, the plants being healthier generally and yielding heavier crops of fruit. The tomato plants are obviously supplied with a steadier supply of water in the buckets, a factor in the development of fruit which all growers will appreciate.

Chrysanthemums also exhibit a marked difference in the general growth and quality of the bloom when grown in the bucket as compared with pots.

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Appointment of Guide Demonstrator to the Rothamsted Experimental Station.

FOR many years past parties of farmers have visited the experimental fields at Rothamsted and every season since the Armistice the numbers of visitors have further increased. The authorities at Rothamsted desire to encourage these visits and they endeavour by all means in their power to make them useful and interesting to farmers.

The generosity of the Fertiliser Manufacturers' Association and of the British Sulphate of Ammonia Federation has enabled a great step forward to be made. Funds have been placed at the disposal of the Rothamsted Committee which have permitted them to appoint a special member of the staff for the purpose of explaining the plots to farmers and others. Mr. H. V. Garner, B.A., of the School of Agriculture, Cambridge, has accepted the post, and it now becomes possible, therefore, to accommodate more parties, and, it is hoped, with even better results, than could be done before. Dr. Russell will be happy to arrange with the Secretaries of Farmers' Clubs, Chambers of Agriculture, and other bodies interested, for visits to the plots. Among other important items of interest are: experiments on the manuring of arable crops, especially wheat, barley, mangolds, and potatoes; manuring of meadow hay; effect of modern slags and mineral phosphates on grazing land, hay land, and arable crops; crop diseases and pests; demonstration of good types of tillage implements, tractors, etc. At any convenient time between 1st May and 1st October there is sufficient to occupy a full day, and alternative arrangements are being completed; even if the weather turns out too bad to allow for close inspection of the fields, which will ensure that the time will not be lost.

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Care in Purchase of Copper Sulphate.

IN September, 1921, the Ministry's Inspectors were instructed to obtain some samples of Blue Vitriol (Sulphate of Copper) as sold for wheat dressing. The Inspectors were instructed to ask for "a pound of Blue Vitriol for wheat dressing." Sixty-nine samples were purchased and submitted to the Government Laboratory.

Fifty-five of these contained 98 per cent. or more of Copper Sulphate, and 7 contained 96 per cent. or more of Copper Sulphate, together with small proportions of impurities, mainly Green Vitriol (Sulphate of Iron). The remaining samples con-

tained a low percentage of Copper Sulphate and gave the following results:—

Copper Sulphate. per cent.		*Iron Sulphate.* per cent.		*Insoluble in Water.* per cent.		*Lime.* per cent.		*Tar Acids.* per cent.
15·8	...	81·0	...	1·2	...	—	...	—
13·1	...	84·8	...	0·9	...	—	...	—
42·3	...	49·2	...	0·8	...	0·8	...	0·18
23·0	...	72·5	...	1·3	...	0·5	...	0·57
26·5	...	69·0	...	1·2	...	Trace	...	0·12
28·8	...	70·3	...	0·2	...	Trace	...	0·17
51·2	...	46·6	...	—	...	—	...	—

In these 7 cases the article would be quite valueless for wheat dressing, potato spraying, or any other agricultural or horticultural purpose for which Blue Vitriol is generally employed, and the result of the inquiry shows that farmers and gardeners should exercise care in the purchase of Copper Sulphate. The following points are of value:—

(1) The deep blue colour of unadulterated Blue Vitriol is quite distinctive, and when it has once been seen no mixture is likely to be mistaken for it.

(2) The label on the package should be noticed. If it is labelled "Blue Vitriol" or "Copper Sulphate" and this description is incorrect the seller is liable to a prosecution under the Merchandise Marks Act. If, however, the package is labelled "Powdered Vitriol" or by a fancy name the contents may not be Blue Vitriol.

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Royal Patronage for Poultry Keepers.

THE fact that His Majesty the King has consented to become Patron of the National Utility Poultry Society will be noted with satisfaction by all who are interested in the development of the poultry industry in this country. This mark of Royal approval may be read as a sign that poultry farming, which has hitherto been regarded as the "Cinderella of Agriculture," is now beginning to emerge from its lowly estate, and to claim a more prominent position. Progressive farmers all over the country are paying more attention to poultry than ever before. They realise that, in view of the huge imports of eggs and poultry from abroad, there must be a strong and steady demand for the home-produced article. They also know that the ordinary farmer, whose normal cultivations produce a variety of food suitable for poultry feeding, can engage in poultry farming more economically and on a larger scale than anyone

else. Nevertheless it should not be forgotten that the great progress which has been made in improving the productivity of British breeds of poultry is almost entirely due to the efforts of specialist poultry breeders, the majority of whom are not farmers at all in the ordinary sense of the word, and are usually quite "small men."

* * * * * *

Blindness in Strawberries.

The term "blindness" has been somewhat loosely applied by growers, and has been wrongly used to describe failure of plants to produce fruit from causes such as frost, eelworm, red-plant, and other forms of insect attack and fungoid disease. There is, however, a well-known form of blindness in strawberries, and it is to be found to a greater or less extent in all varieties. It is easily recognisable to those who carefully examine their crops, by the presence of strong growing luxuriant foliage-producing plants which do not flower. These plants in turn produce strong healthy runners, which are, as a rule, more robust than those produced by plants bearing a normal crop of fruit. The runners of such blind or barren plants seldom produce fruitful stools, but show a marked tendency in turn to produce abnormal foliage and no flower. A small percentage of blind plants in a large area does not seriously affect the crop, but when they appear in a small plot they materially decrease it.

The small grower, cottager and allotment holder are very apt to select strong runners from these barren plants to renew the strawberry patch, and in cases where only a few rows are grown for home consumption, it is a very easy matter under such a process of selection for the patch to become quite barren in a few years. This often occurs in small gardens, and the only safe course is to mark barren plants during the fruiting season and exercise the greatest care that runners are not taken from them later to extend the plantation.

Where strawberries are specially selected for forcing purposes, it is best to isolate stock plants which have been observed to be healthy and heavy bearers and only propagate from such. Stock plants should be selected the first season as soon as they have bloomed and the fruit set; they should receive special cultural attention to enable them to throw strong healthy runners, which should produce strong crowns before any attempt is made to force them in pots or frames. The larger growers should mark blind plants and after the fruiting season destroy them.

It is generally agreed that certain varieties of strawberries have a tendency to throw more barren plants than others, and although they appear under the best soil and manurial conditions, it is also possible that poor cultural conditions have some effect in their production.

Blindness in strawberries is apparently on the increase and therefore only runners from fruitful plants, no matter what the variety, should be selected.

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Wart Disease: Immunity Trials of Potatoes, 1922.

THE Ministry has arranged to continue the testing of new varieties of potatoes during the coming season at the Testing Station of the National Institute of Agricultural Botany, with a view to the establishment or otherwise of their immunity from wart disease. Entries for the trials closed on 15th February.

Thirty-five seed-size tubers are required of any stock which has not before been tested at the Station; in other cases, 70 seed-size tubers are required. The Ministry accepts no responsibility for the failure of the growth of any stock. All reasonable precautions are taken to secure that none of the potatoes on the trial plots shall leave the Station except for exhibition or scientific purposes authorised by the Ministry. At the close of the season a report on each stock forwarded will be furnished to the grower.

When the Ministry has decided, as a result of the trial, that a variety is immune from wart disease, it will formally approve the variety and issue an official certificate of immunity. A certificate will not be issued for any variety until it has passed at least two consecutive years' tests without contracting the disease, nor will a certificate be issued for a variety which is declared by theSynonym Committee of the National Institute of Agricultural Botany to be synonymous with an existing variety.

With regard to the testing of seedlings, the Ministry desires to encourage the breeding of new varieties of potatoes, and is prepared to accept from 5 to 10 tubers of any seedling for growing for one season on the trial plots, and to furnish a report on the results. These tests, however, will not be reckoned in the minimum period of two years required for a variety to pass the full test before approval.

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AGRICULTURE ABROAD.

AGRICULTURAL PLOTS FOR RURAL SCHOOLS IN SPAIN—PLANT IMPROVEMENT LAW IN CZECHO-SLOVAKIA.

Agricultural Plots for Rural Schools in Spain.

WITH the object of checking the growing exodus of population from country to town, and reducing the emigration of land-workers whose means and lack of instruction do not allow them successfully to compete with other countries under modern conditions, a Spanish Royal Order has been made establishing a scheme of agricultural instruction in rural schools. Provision is made for plots of land to be obtained by schools to enable teachers to instil into their pupils a love of nature and of country life and to develop their powers of observation. As there are insufficient teachers having the necessary knowledge and training, not more than a trial of the scheme can be made at present. The subjects to be taught are :—use of fertilisers, especially chemical manures; influence of selected seed on the harvest; rotation of crops; preparation of the land and the use of machinery, especially the type of plough most suitable for local soils; use of insecticides; study of local climate as it affects crops; and the use of a simple system of book-keeping.

A request for the addition of a plot to a school may be made by municipalities, teachers, agricultural syndicates, or associations of experts, with the concurrence of the master of the school concerned, provided that they can obtain land to the extent of 1 hectare (nearly 2½ acres) which can be devoted to the objects of the scheme for at least six years. Various specified instruments must be kept for obtaining records of local climatic occurrences, and the books will be open to the public for the better training of the latter. One day each week the school children will be taken to the plot to see the work being performed and to have it explained to them; and the teacher is recommended to arrange similar lessons for adults on public holidays.

After paying all expenses of the plot, the net profit will be disposed of as follows:—50 per cent. to improvements of the plot, 25 per cent. to the School Mutual Benefit Society, or, failing that, to the canteen, wardrobe, holiday fund, or other special institution connected with the school, and the remaining 25 per cent. to the manager or foreman of the plot. Each plot will have a national subsidy of 1,000 pesetas (nominally about £40) annually to defray rent and other necessary expenses. This

subsidy may be doubled if the plot comprises 2 hectares of land. The Director General of Elementary Schools is to draw up rules for conducting and inspecting the school plots, and for holding competitions to award prizes to teachers who obtain the best results.

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Plant Improvement Law in Czecho-Slovakia.

WITH the object of improving plant cultivation, the new State of Czecho-Slovakia has introduced a law providing for the registration of varieties of plants as "original" varieties, and, after protracted trials, as "guaranteed" varieties, and for the examination of seeds and plants for variety.

The administration of the Act is vested in the Czecho-Slovakian Ministry of Agriculture, who have delegated their powers of inspection to Commissioners. In applying for a certificate to register a variety as an "original" variety, the grower must prove, to the satisfaction of the Commissioners, that the variety in question has been obtained by means of a systematic process. He must agree to an inspection of his trial grounds and laboratories, but the Commissions are bound to observe strict secrecy with regard to any special methods or installations.

A register is maintained at the Ministry of Agriculture of all "original" varieties recognised by the Commissions, showing the name of the producer, a short description and essential qualities of the variety, the method of production, the terms of the label issued to the grower for the purposes of sale, etc. A certificate of "original" variety holds good only for three years, unless renewed.

"Original" varieties, which prove satisfactory during comparative tests made over a period of years on selected areas by the Institutes and Stations set up for controlling the trade in seeds and plants, may be recognised as "guaranteed" varieties, a register of which is also maintained at the Ministry of Agriculture. With both registers are kept samples of the seeds, ears, or fruit of the "original" or "guaranteed" varieties. The registers and samples are open to public inspection.

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Foot-and-Mouth Disease.

SINCE 19th February, the date referred to in the Note contained in the *Journal* for March, 1922, 242 further outbreaks of foot-and-mouth disease have been confirmed in Great Britain, making a total up to Sunday, 19th March, of 1,029. This number is distributed throughout England, Scotland and Wales as follows:—England, 936; Scotland, 91; Wales, 2.

The counties which have been the most heavily infected are Cheshire, Durham, Lancashire, Lindsey (Lincs), Norfolk, Northumberland, Nottingham, Westmorland and York. Those in Scotland are Forfarshire and Renfrewshire. Out of the 936 outbreaks in England, 533 occurred in Yorkshire. The number of animals slaughtered by the Ministry in connection with all outbreaks up to 19th March is 21,510 cattle; 17,971 sheep; 8,575 pigs and 41 goats; totalling 48,097 animals. The percentage of the animals slaughtered to the total livestock population is shown in the following table:—

	Infected Counties only.		*Whole of Great Britain.*	
	No. of Livestock.	*Percentage slaughtered.*	*No. of Livestock.*	*Percentage slaughtered.*
Cattle	3,352,630	0·64	6,659,859	0·32
Sheep	9,859,532	0·18	20,490,024	0·09
Pigs	1,568,041	0·55	2,650,964	0·33

The estimated net cost of compensation for animals so slaughtered will amount approximately to £65,000 after deducting the estimated receipts for the salvage of carcasses passed as fit for human consumption.

In each outbreak the local circumstances are considered by the Ministry with a view to determining whether they are specially favourable to the adoption of isolation in lieu of slaughter. The policy of slaughter, however, has not been superseded, and isolation is only decided upon where the situation of the farm and arrangements for housing the stock are peculiarly suited to such a course. The question of isolation assumes more importance where valuable pedigree herds are concerned. Moreover, the expenditure of a large amount of public money on slaughtering is not justified in cases in which proper arrangements can be made for isolating affected animals with practically no risk of the spread of infection. This course had been followed with respect to 43 outbreaks in England and 8 in Scotland up to 19th March.

An important Order was issued on 9th March revising the rules to be observed on foot-and-mouth disease infected places, with the principal object of securing a more thorough disinfection both of the premises and also of the clothing of persons entering or leaving infected places.

Restrictions on Movement. The restrictions on the movement of animals which, as stated in the *Journal* for March, 1922, were applied on 5th February to the whole of Great Britain, were modified on 27th February by releasing altogethor the whole of the Northern counties of Scotland down to, but not including, Forfarshire, Perthshire, Dumbartonshire and the portion of Argyllshire south-east of Loch Fine; the Isle of Arran was also included in the released district. The effect of this Order was to allow the free movement, and the holding of markets and sales, of all classes of stock within the released part of Scotland, and the movement of animals out of such part into any other part of Great Britain subject to obtaining the necessary licences from the Local Authority of the place of destination. No movement, however, into the released area from any other part of the country was allowed.

On 6th March a new Order came into operation revising the restrictions generally. This Order released from restrictions altogether the South-western counties of England and South Wales, as well as the Northern half of Scotland. The remainder of Great Britain was divided into 4 scheduled districts within which movement was allowed for all necessary purposes with a licence of the Local Authority of the place of destination, which licence was required to be endorsed by the Local Authority of the place from which the animals were moved. Within these 4 scheduled districts certain infected areas surrounding outbreaks or groups of outbreaks were declared. Out of these infected areas no movement was allowed to take place except direct to a slaughterhouse in one of the 4 scheduled districts for slaughter within 48 hours of arrival thereat, and no farm dispersal sales were allowed to be held within those infected areas. Throughout the scheduled districts store stock sales continued to be prohibited, but fat stock markets could be held by licence of the Local Authorities subject to veterinary inspection. No animals could be moved from the scheduled districts to any of the released areas for any purpose whatever.

On 17th March the last-mentioned Order was amended so as to add the whole of North Wales and Berkshire, Hampshire and the Isle of Wight to the released areas and also for the purpose of empowering Local Authorities to license the holding of farm dispersal sales in infected areas, subject to the conditions that (*a*) no such sale was to be held within two miles of an infected place; and (*b*) that licences should be obtained for movements from such sales to the places of destination, but that no movements should be allowed from such sales to premises within a radius of two miles from an infected place.

The following is an extract from a circular letter sent by the Ministry on 15th March to Local Authorities when issuing this Order:—

> "The Ministry considers that the risk of the spread of disease by the holding of dispersal sales on any premises within a radius of 2 miles from any existing infected place renders it inadvisable to allow such sales on premises so situated at the present time, and has accordingly provided that no licences shall be issued in these cases. It may also happen that although a licence for the holding of a sale has been issued by the Local Authority, the removal of all or some of the animals therefrom to the intended places of destination by their purchasers may be prevented by prohibitive regulations of Local Authorities of the receiving districts. In all such cases both the incoming and outgoing tenants will be placed in a position of considerable difficulty as regards the keep of the animals on the premises where they are detained. With a view to minimising these difficulties as far as practicable, the Minister made the Order entitled the 'Foot-and-Mouth Disease (Change of Occupation) Order of 1922,' dated the 13th instant. This Order provides that where, owing to the termination of his right of occupation of any land, the owner of livestock kept thereon is unable to remove the same by reason of the foot-and-mouth disease restrictions, the incoming occupier shall afford the owner of the livestock all such facilities for tending, feeding or using the stock, or for the sale of the stock (where the sale is licensed) as he may reasonably require; and that where the owner is unable to avail himself of such facilities the incoming occupier

shall take reasonable steps for the proper feeding, tending or otherwise using of the stock, the owner of the stock being liable to pay to the person affording such facilities or services such remuneration or expenses as may be reasonable and just, the amount of which, in default of agreement, is to be determined by arbitration in accordance with the provisions of the Second Schedule to the Agricultural Holdings Act, 1908."

Up to 19th March the restrictions which prevented the landing of animals from Ireland otherwise than for the purpose of immediate slaughter continued in operation, but the Ministry has under consideration certain proposals for the landing of store stock subject to conditions which would prevent the aggregation of such stock in markets in this country.

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Conciliation Committees in Agriculture.

THE division of the Lincoln Interim Conciliation Committee into two Committees, one for Holland and the other for Lindsey and Kesteven, and the separation of Loughborough from Leicester and the subsequent formation of separate Committees for those areas, has increased the total number of Conciliation Committees to 61. This number will be further increased on the sub-division of the West Sussex area into three separate districts, which it is understood will take place on the 1st April.

Details of the 42 agreements in operation on the 20th March are given below. In many areas where the current agreements are due to expire at an early date, the Committees have already arrived at further agreements. Particulars of these additional agreements are not included in the subjoined table, but detailed information as to the rates applicable in any area will be furnished on application to the Ministry.

Current Agreements.

Area.	*Period.*	*Wages.*	*Hours per week.*
Beds and Hunts	Up to 22nd July, 1922	32/-. Overtime, 8d. per hour.	52
Cambridge - -	Until such time that one side gives notice of alteration.	8d. per h. for week of 50 h. Overtime 8d. per h. up to 54 h.; 10d. on Sundays.	
Cheshire - - -	Up to 30th April, 1922	36/-. Guaranteed week of 54 hours. Overtime, 9d. per hour on weekdays, 10d. per hour on Sundays.	
Cumberland and Westmorland	" 3rd June, "	32/6. Overtime, 10d. per hour. Skilled workers, 45/-	54 in Summer. 48 in Winter. 63
Derby - -	" 31st March, "	36/-. Overtime, 8d. per hour on weekdays, 11d. per hour on Sundays.	54
Devon - -	" 25th March, "	34/-	50
" - -	" 29th Sep. "	32/-	50
Dorset - -	" 29th April, "	32/-. Carters, cowmen and shepherds, 7½d. per h. up to 60 h. 9½d. per h. over 60 h.	51

Area.	*Period.*	*Wages.*	*Hours per week.*
Durham	Up to 13th May, 1922	42/-.	50
*Ely, Isle of	„ 31st May, „	31/-. Overtime, 8½d. per hour. Horsemen and milkmen, 40/6.	51 Customary
Hampshire	„ 31st March, „	32/- guaranteed week of 48 hours. Overtime, 8d. per hour.	48
Hereford	„ 30th Sep., „	30/-. Proportionate rate per hour for all weekday overtime. Sundays, 9d. per hour.	50
Hertford	„ 6th Oct., „	7½d. per hour. Guaranteed week of 50 hours.	
Lincoln :—			
Holland	„ 30th June. „	8d. per hour for all hours worked.	
Kesteven and Lindsey	„ 31st Oct. „	7½d. per hour. Guaranteed week of 50 hours.	
Lancashire :—			
Southern area	„ 31st March, „	45/- Tramsmen and stockmen. Rates for other workers in proportion.	Customary.
Northern area	„ 31st „ „	42/6	Customary.
Eastern area	„ 31st „ „	50/-	Customary.
Leicester :—			
Ashby Bosworth, Hinckley and Atherstone	„ 31st „ „	35/-. Overtime, 10d. per hour on weekdays, 1/- Sundays.	50
Market Harborough and Lutterworth	„ 30th Sep., „	31/-. Overtime, 8d. per hour on weekdays, 10d. per hour on Sundays.	51
Middlesex S.	„ 2nd Sep., „	35/5. Guaranteed week of 48 hours. Weekday overtime, 10d. per hour. Sunday employment, 11d. per hour. Carters, stockmen, &c., 8½d. per hour up to 60 hours. Weekday overtime, 10d, Sunday employment, 11d. per h.	
Northants	„ 6th Oct, „	31/-. Overtime, 8d. per hour.	50
Northumberland, S.	„ 13th May. „	44/6. Overtime, 1/1½d. per hour on weekdays. Sundays, 1/4d. per hour.	50 in Summer 48 in Winter.
Nottingham	„ 30th Sep., „	34/-	53

Area.	*Period.*	*Wages.*	*Hours per week*
Norfolk -	- Until beginning of Harvest.	30/-	50½
Oxford -	- Up to 29th Sep., 1922	30/-. Overtime, 8d. per hour on week-days. Sundays, 10d. per hour.	50
Peterborough, Soke of	" 6th Oct., "	31/-. Overtime up to 54 hours, 8d. per hour; over 54 hours, 9d. per hour. Sunday employment, 10d. per hour. Horsekeepers and milkmen, 7/- plus cottage, and stockmen 5/ per week extra for performance of their customary duties.	51
Rutland -	- " 28th Oct., "	32/-. Rates to vary 1/- for every change of 6 points in cost of living. Overtime 8d. per hour week days, 10d. Sundays.	50
Shropshire	- " 30th Sep., "	7½d. per hour. Guaranteed week of 50 h. Sunday employment, 10d. per h.	
Somerset -	- " 30th April, "	32/-	50
Stafford -	- " 29th " "	8d. per hour. Guaranteed week of 50 h. Sunday employment, 10d. per h.	
Surrey* -	- " 25th March, " (Male workers of 21 to 65 years).	33/4. Overtime, 9d. per hour. Carters, cowmen and shepherds, all time worked between 50 and 60 hours per week 8d. per hour, and all time worked by these classes in excess of 60 hours, 9d. per hour.	50
Sussex, E. -	- Up to 31st March, 1922	31/-. Overtime, 8d. per hour.	52
Suffolk -	- " 31st Oct., "	7½d. per hour up to 50 hours per week. Between 50 and 54 hours, 8d. per hour. In excess of 54 hours, 9d. Sunday employment, 10d. per h.	
Warwick* -	- " " 6th Oct, " (able-bodied adult male workers).	31/-. Guaranteed week of 50 hours. Overtime, 8d. per hour.	

* Confirmed agreement.

Area.	*Period.*	*Wages.*	*Hours per week.*
Wight, Isle of -	Date of next meeting, or such other date as may be agreed.	32/-	Ordinary.
Worcester -	Up to 6th Oct., 1922	7½d. up to 60 h. Guaranteed week of 50 h. Overtime beyond 60 h. 9d. per h.	
Yorkshire, North Riding	„ 31st Oct., „	35/-. Overtime at proportionate rates	52½
West Riding -	„ „ „	36/-. Overtime at 9d. on weekdays and 10d. on Sundays.	54
Brecon and Radnor	„ 30th April „	34/-. Overtime, proportionate rates up to 60 hours. In excess of 60 hours, at time and a quarter.	52
Carnarvon - -	„ 13th May „	35/-. Special classes workers, 38/-. Overtime, all classes 10d. per hour.	50 61
Cardigan - -	„ 31st Oct. „	36/-	54
Merioneth and Montgomery	„ 30th April „	33/- 36/-	50 56
Monmouth - -	„ „ „ „	35/-	54
Pembroke - -	„ 4th Oct. „	34/-. Overtime at equivalent rate up to 60 hours. In excess of 60 hours, time and a quarter.	54

The North Northumberland Committee, which was delayed in its initial negotiations pending the division of the original Northumberland Interim Committee, decided that as the November hirings had already taken place it was unnecessary to deal with the wages question for the period up to May next. An agreement has now been arrived at by that Committee over the period 12th May, 1922, to the 12th May, 1923, for the payment of adult male workers at the rate of 32/- for a week of 50 hours in summer and 48 hours in winter.

The Surrey Conciliation Committee has agreed to extend their present agreement, which would otherwise expire on the 25th March. In accordance with the Committee's application, this agreement has been confirmed by the Minister and provides as follows:—

(*a*) A wage rate for all male workers between the ages of 21 and 65 years of 33/4 for a working week of 50 hours.

(*b*) All time worked between 50 and 60 hours per week by carters, cowmen and shepherds between 21 and 65 years of age to be paid for at the rate of 9d. per hour; in the case of all other male workers between the ages of 21 and 65 years any time worked in excess of 50 hours per week to be paid for at the rate of 9d. per hour.

(*c*) All the rates specified to apply only to workers whose employment is terminable by a week or longer notice, and to operate until one calendar month after notice of any proposal to cancel is received by the Minister from either section of the Conciliation Committee.

Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE,
By Metchim & Son, Princes Street, Westminster, S.W. 1.

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXIX. No. 2.

MAY, 1922.

NOTES FOR THE MONTH.

Milk Prices.

At a meeting held at the Ministry of Agriculture on Wednesday, 12th April, 1922, under the Chairmanship of the Minister of Agriculture, Sir Arthur G. Boscawen, the representatives of the producers and distributors announced that they had agreed to recommend to the organisations concerned that the price to be received by the producer for milk delivered into London from areas outside the Home Counties should be: April, 10d.; May and June, 9d.; July, 11d.; August and September, 1s. per gallon, which represents an average for the six months of 10½d. per gallon. The price to be paid for milk delivered to creameries within 100 miles by rail of London should be as follows:—April, 9d.; May and June, 6d.; July, 7d.; August, 8d., and September, 9d. per gallon, which represents an average for the six months of 7½d. per gallon.

Milk delivered to creameries at a greater distance than 100 miles by rail from London would be paid for at the same rate less the increased cost of railway transport to London.

It was agreed that the revised prices should be retrospective to April 1st, and that those farmers who had already entered into contracts should receive the benefits accruing under the above arrangement.

The Minister understands that in the case of certain distributors, contracts have been entered into to supply milk based on prices ruling previous to this agreed alteration, and he hopes that in such cases the holders of such contracts will agree to a revision in accordance with the altered terms to the producer.

The price to the consumer of 5d. a quart which had previously been announced for the 3 months of April, May and June will not be raised during that period.

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(42802) P.14/35. 11,000. 5/22. M. & S A

Agricultural Research and the Farmer.*

THE Ministry will shortly issue a report on Agricultural Research which describes clearly, for the benefit of farmers and others, the scientific work now in progress in the interests of agriculture. Hitherto, if a farmer inquired what the research worker was doing for his industry, he could only be referred in the main to technical papers published in scientific journals, and these, even if intelligible to him, contained results which might be apparently remote from farming practice. The practical man realises that while these highly scientific investigations may not immediately help him in securing increased returns, they are vital to the industry, for progress depends on the acquisition of knowledge. The farmer and gardener reap the benefit of research after it has passed through various experimental channels, and when the results have been put to the crucial test of experience in the field. This may be some years after the patient toil of the scientist in the laboratory. Many farming operations which are commonly practised to-day can be traced back to discoveries made years ago by scientists who at the time had only a faint conception—if any at all—of the use to which their results would eventually be put.

For some time past, however, the need has been felt for a comprehensive and readable account of the important research which is being conducted in agriculture and horticulture.

The Ministry consequently commissioned one of its officers, Mr. V. E. Wilkins, to visit Institutions where research is being conducted, and prepare a report which would not only describe the work in a readable and non-technical style, but would link together as far as possible the various phases of investigation, and show their relation to the practical problems of the farmer. The report deals with all aspects of research, and contains ten chapters, devoted respectively to the soil, plant breeding, plant physiology, fruit growing and preserving, plant diseases, animal husbandry, animal breeding, dairying, animal diseases, and farming as a business. A list of Research Institutions and Advisory Centres in England and Wales, and a Bibliography giving the titles of papers published by research workers in 1920 and 1921, are included as Appendices. A prefatory note has been written by Sir Arthur G. Boscawen, Minister of Agriculture and Fisheries, in which he refers to the

* Agricultural Research and the Farmer: A Record of Recent Achievement, Published by H.M. Stationery Office, Imperial House, Kingsway, W.C.2. price 2/6 net; obtainable through any Bookseller or direct from the Publisher.

report as an attempt to remedy the existing fault in the line of communication between the research worker on the one hand, and the farmer and the general public on the other. Sir Arthur also expresses the hope that the farming community and the general public will show by the practical test of buying the volume that the attempt has been successful.

* * * * * *

Remission of Duty on Home-grown Sugar.

IN reply to a question in Parliament on the 30th March, the Minister of Agriculture, Sir Arthur G. Boscawen, said:—"The Government have decided that, in view of the exceptional conditions of this new industry, and the condition of unemployment in this country, no excise duty should be charged on **home-grown sugar,** and the necessary provision for the removal of the existing duty will be made in the Finance Bill of this Session. It is of course impossible to bind any future Government, but in view of the fact that the remission of excise is intended to assist a new industry during the experimental period, it may be hoped that Parliament would not re-impose any excise duty until the industry has been firmly established."

* * * * * *

Appointment of Departmental Committee on Foot-and-Mouth Disease.

THE Minister of Agriculture and Fisheries has appointed a Departmental Committee "to inquire into the origin and circumstances of the recent outbreak of Foot-and-Mouth Disease and into the policy and procedure which was pursued in dealing with the disease, and to report whether any alteration of the methods of administrative control hitherto adopted, or any amendment of the existing law is necessary or desirable."

The Committee is constituted as follows:—

Capt. the Rt. Hon. E. G. Pretyman, M.P. (Chairman).
A. Batchelor, Esq.
David Ferrie, Esq.
F. W. Garnett, Esq., C.B.E., J.P.
H. German, Esq.
William Graham, Esq., J.P., D.L.
Alfred Mansell, Esq.
Sir G. Douglas Newton, K.B.E., M.P.
Professor John Penberthy, J.P.
W. R. Smith, Esq., M.P.

The Secretary of the Committee is Mr. S. A. Piggott, Ministry of Agriculture and Fisheries, 4, Whitehall Place, S.W.1, to whom all communications should be addressed.

* * * * * *

Report on the Produce of Crops in 1921.

THE Ministry's Crop Reporters estimate the yields of the chief crops in the autumn of each year, and the estimates of total production in the country are issued immediately tabulation is completed. These data as regards corn and hay were issued on 2nd November last year; potatoes and roots on 30th November; while those relating to hops were issued earlier on 20th October. The Report now issued gives details regarding the different counties of England and Wales as well as totals for Scotland and Ireland. Attention is drawn in the Report, not only to the special features of 1921 as regards crop production, but also to the relative money value of the grain and potato crops as compared with previous years. The use of forecasts of the yields of crops made before harvest, as well as of returns of production made after harvest when the actual results are known, is also discussed as regards their bearing on world trade.

This Report, which forms Part II of the Agricultural Statistics for 1921, can be obtained through any bookseller or direct from His Majesty's Stationery Office, Imperial House, Kingsway, W.C.2, and 28, Abingdon Street, S.W.1.

* * * * * *

Conciliation Committees in Agriculture.

THE Conciliation Committees continue to work satisfactorily, and the total number of agreements in operation on 20th April was 45. The question of milk prices has no doubt been somewhat responsible for delaying negotiations in certain cases, but in most areas where no wages agreement exists, the Committees have arranged to hold further meetings at an early date.

A full statement of the agreements in operation on 20th March was given in the April issue of the Journal. The agreements reached during the succeeding month are as follows:

Current Agreements

Area.	*Period.*	*Wages.*	*Hours per week.*
Derby	Up to 30th June, 1922	7½d. per hr. for all employment on weekdays. Sunday employment 10d. per hr.	

Current Agreements.

Area.	*Period.*	*Wages.*	*Hours per week.*
Hampshire -	Up to 11th Oct., 1922	7½d. per hr. for all employment. Guaranteed week of 50 hr.	
Lancashire—			
Southern area -	„ 30th Sep., „	42/6	Customary hr.
Eastern area -	„ 30th „ „	45/-	„
Northern area -	„ 30th „ „	42/6	„
Leicester—			
Melton Mowbray and Belvoir	„ 30th „ „	32/-. Weekday overtime 8d. per hr. Sunday employment 10d. per hr.	53
Leicester -	- Until such time that one side gives notice of alteration.	7½d. per hr. up to 54 hr. Guaranteed week of 54 hr. Weekday overtime 8d. per hr. Sunday employment 10d. per hr.	
Loughborough -	Until such time that one side gives notiee of alteration.	7½d. per hr. up to 54 hr. Guaranteed week of 54 hr. Weekday overtime 8d. per hr. Sunday employment 10d. per hr.	
Denbigh and Flint	Up to 10th Sept., 1922	31/3d. Overtime, proportionate rate up to 61 hr.; over 61 hr. 9d. per hour.	50
		Stockmen and waggoners, 38/1½d.	61

Full details of the agreement for any particular area will be furnished on application to the Ministry.

* * * * * *

The Agricultural Index Number.

THERE was practically no change in the average of the market prices of all descriptions of agricultural produce during March as compared with the previous month, the general level of these prices being 82 per cent. above the average of the three years 1911-13 as against 83 per cent. in February.

The percentage increase during each month from January, 1919, as compared with the pre-war years, is shown in the following table:—

Month.	1919. *Per cent.*	1920. *Per cent.*	1921. *Per cent.*	1922. *Per cent.*
January	148	213	186	77
February	150	205	172	83
March	150	199	158	82
April	153	199	141	—
May	132	169	112	—
June	128	164	102	—
July	141	174	100	—
August	138	177	116	—
September	148	181	105	—
October	166	191	90	—
November	182	197	84	—
December	207	194	82	—

Considerable changes have taken place in the prices of certain commodities, the principal increase being in the case of fat sheep. The average price of fat sheep in March was 120 per cent. above the average of 1911-13, as compared with 83 per cent. in February and 60 per cent. in January. Other descriptions of fat stock also advanced, although the rise was much less marked than in the case of sheep. Wheat has continued to advance in price, being in March 61 per cent. above the pre-war average as against 45 per cent. in February.

The March price for milk delivered into large towns showed a considerable reduction on the prices for February, while the low prices offered for summer milk were reflected in the fall in the price of dairy cows, which averaged about 37 per cent. more than in the pre-war years as against 89 per cent. in January, this decrease representing a cash difference of about £11 per head. Eggs showed the usual large seasonal reduction and butter was also appreciably cheaper than in February.

Feeding stuffs as a whole showed little change in price since February. Millers' offals declined 7 points but this fall was compensated by a rise in the price of maize, while oilcakes, brewers' grains, maize meal and barley meal remained practically unchanged.

Among fertilisers, superphosphate depreciated slightly in value, but nitrate of soda and sulphate of ammonia were dearer, while basic slag remained unchanged. The general average prices of feeding stuffs and fertilisers were estimated to be between 50 and 60 per cent. above the pre-war average.

* * * * * * *

Foot-and-Mouth Disease.

SINCE 19th March, the date referred to in the note contained in the *Journal* for April, 1922, 50 outbreaks of foot-and-mouth disease were confirmed in Great Britain up to 23rd April, making a total of 1,079 outbreaks, which included 978 in England, 2 in Wales and 99 in Scotland. These additional outbreaks all occurred in counties which had been previously affected, but in one instance disease reappeared in a county (Warwickshire) from which restrictions had been withdrawn.

The Ministry has now been able to authorise the freedom of a large proportion of the earlier infected premises, and the total number of premises in Great Britain so freed up to 23rd April was 707. Restrictions have also been withdrawn from a number of counties in England and Scotland.

The total number of animals slaughtered up to 23rd April was 52,195, viz., 22,666 cattle, 20,276 sheep, 9,206 pigs and 47 goats.

Modifications of Restrictions on Movement since 19th March.—Representations were received that (*a*) the resumption in some form of the trade in store stock was becoming essential in order to make use of the summer grazings; and (*b*) that the return of wintering sheep to their summer grazings could not be delayed after about 1st April. The Ministry therefore made an Order re-opening the store stock trade from Ireland from 29th March without allowing the aggregation of store stock in internal markets, which was still considered to be attended with risk. The Order allowed the landing of store stock subject to licence of the receiving Local Authority and to the stock being railed direct to their farms of destination for 28 days' detention. No obstacle was placed in the way of the holding of store stock sales in the landing places, and Local Authorities still had powers to prohibit the movement of the cattle into their districts if they thought fit. All trucks were required to be specially disinfected before the animals were placed therein. As regards the return of wintering sheep an Order was made taking effect on 5th April enabling sheep not in existing infected areas to be moved to any premises in Great Britain by licence of the receiving Local Authority after counter-signature by the sending Local Authority and after the sheep had been examined by a Veterinary Inspector of the sending Local Authority. A further examination of the sheep on arrival at their destination was required and railway trucks conveying them were required to be specially disinfected before being used for the sheep.

Note.—**The figure of £65,000 given in the April issue of the *Journal*, p. 91, as the cost of compensation for animals slaughtered should have read £655,000.**

GREEN MANURING.

H. J. PAGE, M.B.E., B.Sc., A.I.C.,
Rothamsted Experimental Station.

The Scarcity of Animal Manure and its Causes.—One of the most serious practical problems with which the farmer is faced at the present time is the shortage of farmyard manure. This manure is almost everywhere more highly esteemed than any other, and it was largely in order to investigate the cause of this well-known superiority that Lawes started at Rothamsted in 1843 the famous field experiments which have now been going on there continuously for nearly eighty years. It is interesting to know that even at that time farmers could not usually get enough farmyard manure, and yet how much better off were they than the present-day farmer!

Let us pause a moment before considering the reasons underlying the value of farmyard manure, and look a little more closely at the extent of, and the factors causing, the present shortage. With regard to the extent of the shortage, the rise in the price illustrates this point sufficiently. At the present time a ton of stable manure on rail in London may cost as much as 7s. 6d., and even then it is often of poor quality; in 1912 the cost was 4s. 6d., while in 1905 it was only 1s., and usually no difficulty was experienced in finding a supply. What are the causes of this enormous change? The obvious one which immediately suggests itself, is the driving of horse transport from the roads by mechanical transport. Whatever the benefits that the tractor has conferred on the farmer in the fields, its elder brothers, the lorry and the motor 'bus have proved for him by no means an unmixed blessing. The returns of H.M. Commissioners of Customs and Excise show that from 1906 to 1920 the number of licensed motor vehicles (excluding motor-cycles) increased by nearly a quarter of a million, whereas licensed horse vehicles decreased by 200,000. When it is borne in mind that the bulk of this fall in horse-drawn vehicles will have occurred in the big stables of commercial firms whence the greater part of the town stable manure is derived, it is not difficult to see why stable manure is now so scarce and dear.

Nowadays, therefore, the farmer is very much more dependent on his beasts for a supply of dung than formerly, and even this supply is not being wholly maintained. The number of head of cattle in Great Britain in 1921 showed a

decrease of 400,000 as compared with 1914, and of nearly 800,000 compared with 1919, while sheep decreased by nearly 4 million between 1914 and 1921. So much as regards a dwindling supply. As to demand, this, so far from dwindling, has increased, for although the number of acres of land under the plough in Great Britain has been steadily falling since 1918, in 1921 it still showed an increase of 800,000 compared with 1914, and the more land there is under the plough, the greater is the need for organic matter.

The Value of Farmyard Manure and the Need for Organic Matter in the Soil.—The shortage of farmyard manure and the causes of that shortage have thus been discussed in order to show that the situation is one which is not likely to improve in the future, but rather is likely to become more serious. Now although every practical man admits the value of farmyard manure, and knows that in order to maintain the fertility of his soil and to keep it in good heart, a plentiful supply of organic matter is indispensable, there is very little certainty as to the mode of action of that organic matter. We know that the main requirements of a crop for mineral substances and nitrogen can be completely satisfied by artificial fertilisers so that it is unlikely that the unique properties of farmyard manure reside intrinsically in the mineral substances and nitrogen it contains. There is indeed the possibility that certain of the rarer elements, such as boron, present in farmyard manure and usually absent from artificials, may play a part in soil fertility —and this question is under investigation at Rothamsted at the present time—but it is practically certain that the superiority of dung is mainly due to the organic, humus-forming material in it. As to the exact nature of "humus" we still know little, and the term, although commonly used, is only one of the many convenient labels which scientists, no less than other mortals, use to hide their ignorance. Humus may be regarded as pre-eminently *the* characteristic constituent of a fertile soil, in which it exists as a gelatinous brown or black material. The influence of humus on the growth of crops is mainly indirect: it is intimately related to the life of the complex soil population of micro-organisms, and it has important effects on the tilth, moisture relations, and other physical properties of the soil. It affects plant growth by so modifying the properties of the soil as to secure a well-regulated supply of the soluble mineral and nitrogenous substances absorbed by the plant roots, and of the water which serves as the vehicle by

which those soluble substances are conveyed to the plant, and without which this "plant food," however plentiful it may be in the soil, cannot be obtained by the plant. A light soil is given more "body" and rendered better capable of withstanding drought, while a heavy soil is made more open and workable. This is not the occasion to discuss the exact mode of action of humus in bringing about these effects, nor for that matter are we in a position to do so with any degree of certainty;* but from the practical point of view the important thing is that these effects undoubtedly exist, and are of great significance.

Alternative Sources of Organic Matter.—It is therefore as a source of humus that farmyard manure must be chiefly prized, and in the face of a growing scarcity the agriculturist is faced with the problem of finding an alternative source of organic matter, that is to say, of keeping part of his soil in good heart without the assistance of animals as manure-makers. What are the possibilities of such alternative supplies? Apart from purely local or undeveloped sources, such as seaweed, which is used in maritime districts like the Channel Islands and many coastal districts of Scotland,† or such as activated sewage sludge,‡ there are at least three possible sources of general applicability. These are (1) The ploughing of raw straw into the soil; (2) The use of artificial straw-manure made by the process of Hutchinson and Richards as worked out at Rothamsted;§ (3) The use of green manures.

With regard to the first method, although the practice of ploughing in raw straw in the autumn is being adopted in some parts, notably on the heavy land in Essex, it is as yet of unproved value. One great danger of such a practice is that the addition of a large bulk of non-nitrogenous, carbohydrate matter to the soil, may cause a temporary locking up of nitrogen by biological agencies in an insoluble form not available to the plant; such an effect, if sufficiently transitory, might be all to the good, as for example, in preventing loss of nitrates by leaching during the winter months, but in other circumstances much harm might result.‖ The question needs careful in-

* For a discussion of this aspect of the part played by humus in the soil, see a paper by the writer in the "*Transactions of the Faraday Society*," *17*, 272 (1922) (General Discussion on Physico-chemical Problems relating to the Soil, held on 21st May, 1921).

† See Ministry of Agriculture Leaflet No. 254.

‡ See *Journ. Soc. Chem. Ind.*, *39*, 177, *41*, 62 T.

§ See this *Journal*, *28*, p. 398, (1921).

‖ See *Journ. Agr. Sci. 9*, 92.

vestigation before the practice can be recommended for general adoption. As to the use of artificial farmyard manure made from straw, there seems to be little doubt that this material will prove a valuable manure, and provided its production on a large scale can be made economically practicable, it will doubtless ultimately find a large application in agriculture. Both of these methods, however, apply pre-eminently to those farms where straw is available in sufficient quantity on the spot, and in a less degree in cases where the straw would need to be brought in. The object of this article is to call special attention to the third method mentioned above, namely, *green-manuring.* In doing so it must be clearly understood that it is as a means of supplementing a dwindling supply of animal manure, and not necessarily as a competitor with animal manure, that green manures are here treated. It is often urged that it is a far more practical proposition to feed a green crop to sheep folded on the land than to plough it in, and on light lands this is no doubt usually the case, but on heavy lands on which sheep cannot be folded, and even on light lands, if sufficient sheep are not available, green manuring merits serious consideration by the arable farmer who does not feed enough stock off the land to supply his requirements of animal manure.

Existing Green-Manuring Practice in this Country.—Few farmers neglect a favourable opportunity of taking a catch crop of a quick-growing nature, such as mustard, between harvest and seed-time, or on a freshly ploughed seeds ley, and turning it in if it is not convenient or practicable to fold sheep on the land or to feed cattle off the land; and to this extent green manuring may be said to be fairly general in this country, but in most districts it cannot be said to play more than a very minor part. The difficulty in ordinary farming is that in any of the usual rotations, after doing the necessary amount of cultivation to keep the land clean it is often too late to get in a green manure crop with any hope of its making sufficient growth before next seed-time. In a normal four-course system of seeds, wheat, roots, barley, the land is seldom available until August, and in a late season it may well be a month later before the harvest is in. Although nowadays the tractor has made it possible to finish the ploughing of stubbles and cultivation for weed-killing in a much shorter time than formerly, in a late season the interval available is usually too short for taking a catch crop. Another factor which adds to the difficulty is the

fact that the land may be so dry after harvest that germination is very bad.

The result is that green manuring forms a regular and essential part of the system of husbandry only in districts given over to special crops, such as the Fens, the Lothians, and Ayrshire, where it is extensively used after early potatoes; the market-gardening districts around Biggleswade; and the flax-growing areas of North Ireland; or in cases where the nature of the soil is such that special rotations are used, as for instance on the London Clay in Essex, where a bare fallow provides the necessary opportunity, or on the light blowy sands of East Anglia, which can often only be profitably farmed by giving one year in four to a nitrogen-gathering crop such as lupins. Another system which is adopted in some parts is to sow the green manure crop in the spring corn, as for a seeds ley, and after harvest to let the green crop grow on till early in the following year before turning it in. Systems of green manuring can thus be classified under three main heads:—(1) Green manure crops grown as catch crops in the intervals in the rotation; (2) Green manure crops grown as part of a special rotation in which the whole or a large part of one growing season is given up to the green manure crop; (3) Green manure crops sown in the spring corn, for turning in the following year.

To the first category belong the systems referred to above as employed by early potato growers. Thus in the famous potato districts of East Lothian and Ayrshire, rape or Italian rye grass, or a mixture of the two, is sown down immediately the tubers have been lifted, in any case not later than the third week in August. Some growers then feed the green crop to sheep, but many prefer to turn the crop in.

Again, in the Holland division of Lincolnshire, and in the black lands of the Fens, mustard, rape and oats are similarly largely used by potato growers as early autumn-sown green manures, and some farmers have latterly been trying beans for the same purpose. In Essex and Suffolk, on the heavy lands of the London Clay, it is a common practice to sow mustard on the bare fallow in July, and plough it in before sowing winter corn; similarly many flax growers in County Down have got splendid results from mustard sown in August after the flax has been pulled, and turned in during January or early February.

The most outstanding example of a system in the second category is that used on the poor light glacial sands of Suffolk. This land is so poor that it scarcely repays cultivation on ordinary straightforward lines, yet by adopting a rotation such as rye, lupins, potatoes, silage crops, it is possible to make farming on this land pay well. The lupins are sown in the late spring or early summer and may be ploughed in either when in flower, or seed may be gathered, and the plant then turned in. The lupins do so well, even on the poorest of this land, that when turned in they give as much organic matter and nitrogen as a dressing of about 8-10 tons of farmyard manure. The use of lupins as green manure on poor sands is extending to other counties, notably Notts., where some striking results have been obtained in trials (*see* Part II in next month's *Journal*).

Of systems in the third category, an example is afforded by the practice common in the market gardening districts around Biggleswade in Bedfordshire, where red or white clover is commonly sown with the corn in spring and turned under in the autumn or the new year, before potatoes. In a moist season the green matter ploughed in is often found to be as effective as a dressing of 25 tons of stable manure. Similarly some of the growers in the Lothians sow rye grass and red clover in the spring corn and turn it under in the following spring. The same practice has been tried in the Aberdeen district, but it is not general there, for owing to the late harvest, green stuff in the bottom of the sheaves adds to the difficulty of drying, and after harvest it is too late for the rye grass and clover to make much growth. Of course the ploughing up of a temporary seeds ley incorporates a large quantity of valuable organic matter in the soil, and to this extent most arable land is green-manured at intervals. The potato growers of Lincolnshire commonly turn in the aftermath of the clover as a green manure, with good results. Where the land is left down to grass for several years, as in the Aberdeen district and many districts in England, the sod of grass which is ploughed down is an excellent green manure, and gives so much nitrogen to the soil that no nitrogenous artificials are needed for a following oat crop, and indeed, their use is liable to cause lodging.

Green Manuring Abroad.—We must, however, go overseas to find the practice of green manuring in its most highly developed state.

An outstanding example on the Continent is that of Germany, where large tracts of barren sandy heath have been reclaimed

and made profitable almost solely by the use of green manures, mainly leguminous; the pioneer work of Schultz at Lupitz, in Saxony, is a well-known instance in this connection. Again, in America green manures are widely used, both for farm crops, and, especially in California, for orchards. It is, however, in tropical countries, perhaps, that green manures find their widest application. Thus in India, in many districts where animal manure is practically unobtainable, the whole of the requirements of the soil for organic matter and nitrogen are obtained by the use of leguminous green manures.

Results of Green Manuring Trials.—Although there are a certain number of results on record showing that distinct and valuable crop increases can be obtained by green manuring, there are very few critical experiments designed to test the relative values of different green crops and different methods of application. The most extensive series of experiments in this country is that carried out by Voelcker at the Royal Agricultural Society's Station at Woburn. In these experiments vetches, rape and mustard were grown side by side as spring-sown green manure crops which were turned in before winter wheat. The experiment has been in progress for over twenty years, and the results are summarised below :—

Yield of Wheat after Green Manures, Woburn, Lansome Field (Light sandy soil).

Average of results for eight seasons 1899, 1901, 03, 06, 08, 10. 12, 15.

	Dressed grain, bush. per acre.
After vetches, grown with mineral manures	16·3
,, rape ,, ,, ,, ...	20·4
,, mustard ,, ,, ,, ...	25·2
For comparison :—	
Wheat on Stackyard Field, complete minerals only ...	9·1
,, ,, ,, farmyard manure (equiv. to 200 lb. ammonia per acre)	20·4

Unfortunately there are no control plots on Lansome Field, so the values for Stackyard Field (continuous wheat) which have been added for comparison, are not necessarily strictly comparable, but they serve to indicate the sort of result that can be obtained with green manures compared with mineral or farmyard manure. An experiment on similar lines was carried out at Rothamsted. Here the land was given up to spring-sown green crops for two seasons, the crop being turned in each autumn, and in the third season winter wheat was grown. The

experiment was then repeated on the same land. The results were as follows:—

Yield of Wheat after Green Manures, Rothamsted, Little Hoos Field (Stiff clayey loam).

	1900.	1917.
After vetches, grown with mineral manures ...	39·7	34·4
„ crimson clover „ „ ...	32·5	30·8
„ rape „ „ ...	21·3	20·8
„ mustard „ „ ...	29·9	19·6
For comparison :—		
Wheat on Broadbalk Field, complete minerals only	11·5	10·0
„ „ „ „ farmyard manure (14 tons per acre) ...	33·7	27·9

Again there were no control plants on Little Hoos Field, but the figures for Broadbalk Field afford a rough basis for comparison. Apart from the obviously beneficial effect of green manures on winter wheat, which is clearly brought out by the above Woburn and Rothamsted results, it will be noticed that the relative values of leguminous and non-leguminous crops, such as vetches and mustard respectively, come out very differently in the two sets of experiments. This is a striking instance of the danger of applying the results obtained in one district on a certain type of soil, to another with an entirely different soil. This difference is further discussed later. Both of the sets of experiments quoted above referred to summer-grown green manures for winter wheat. Trials were started by the writer at the Royal Horticultural Society's gardens at Wisley in 1919 in which green crops were sown in August for digging in late in the autumn or early the next spring, as a preparation for white turnips. Some of the results for 1919-20 are shown below* :—

Green Manuring-Experiment at Wisley, 1919-20. (Light sandy soil).

		Yield of Turnip Roots after green crop.	
Green crop.	*Tons per acre.*	*Tons per acre.*	*Per cent. of control Plot.*
A. Green crop turned under in Spring.			
Crimson clover ...	17·0	10·5	239
Vetches	8·6	9·7	220
Red clover	3·9	9·3	206
Rye	8·4	8·6	195
Rape	9·3	6·4	145
Control	2·2 (weeds)	4·4	100
B. Green crop turned under in Autumn.			
Rye	2·9	6·3	162
Oats...	3·6	6·3	162
Mustard	5·6	5·9	151
Vetch	4·3	5·5	141
Control	0·8 (weeds)	3·9	100

* These results will shortly be published in full in the *Journal of the Royal Horticultural Society.*

As an illustration of the value of lupins on light blowy sands the results may be quoted of an experiment carried out in Notts., for particulars of which the author is indebted to the Agricultural Organiser of that county. Lupins were sown in May, 1920, and turned under in September, and winter oats sown. The land received no farmyard manure or artificials. The oats after lupins yielded 7¼ quarters per acre, while an adjacent control plot on which no lupins had been turned in, yielded only 1½ quarters per acre. This experiment is being extended during the present season.

Many more results of a similar character to those given above could be quoted, but these suffice to demonstrate broadly the very considerable increase in yield that can be obtained by green manuring. As already pointed out, however, a comparison of the Woburn and Rothamsted results serves to show that, as soon as more detailed and precise information is sought with regard to the best system of green manuring to adopt in any particular district, difficulties and uncertainties are encountered. In fact, if green manuring is to find a much more general adoption in this country than at present, it will be necessary for careful experiments to be carried out in different districts before the system best adapted to specified conditions of soil, climate, etc., can be definitely laid down. In order to bring out clearly the complexity of the problem, it is desirable to consider at this point, as far as space and the present state of our knowledge permits, the principles underlying the action of green manures, particularly in comparison with farmyard manure.

(*To be concluded.*)

FARM BUILDINGS FOR SMALL-HOLDINGS:

A WEST RIDING IMPROVEMENT.

MAJOR H. P. G. MAULE, D.S.O., M.C., F.R.I.B.A.,
Ministry of Agriculture.

THE planning of new farm buildings, whether on a large or small scale, presents many problems to the architect, and at no time more than the present, when the results of scientific research are becoming more generally recognised, and many of the old established methods and customs of farming practice are being weighed in the balance. Certain broad and elementary principles of planning may, however, be said to be firmly established and to be applicable to any type of English farming, and it may be well to record some of these before proceeding to discuss the main subject of this paper.

First, buildings must be suited to the nature of the land, the type of farming, and the prevalent climatic conditions.

Secondly, the buildings must be planned with a view to the utmost economy of labour in the care of stock, *i.e.*, in feeding, cleaning and general work, the guiding factor in this being the correct placing of the storage rooms and mixing floor for the collection, preparation, and distribution of fodder.

Thirdly, the health and well-being of stock must not be sacrificed to either of the above considerations by inadequate planning or insufficient area.

Fourthly, attention must be given, especially in the case of the small holder (who cannot be expected to purchase artificials to the same extent as the large farmer) to the adequate conservation and economic distribution of manurial produce.

A careful analysis of many of the existing farmsteads in this country shows that these principles are more often honoured in the breach than in the observance, and even buildings erected in the " golden age " of farming in the last century, leave much to be desired when viewed in the light of modern conditions and practice.

It is to be expected, therefore, that the immediate future will show several variations from existing types, and already there are signs of approaching changes in the construction and placing of cow houses, in the greater attention paid to the conservation

of farmyard manure, in the provision of covered yards, hay and straw barns, and in the use of utility boxes which can be adapted to varying needs.

Any variation from the normal, whether in buildings for large farms or small holdings, should therefore be of special interest at the present time to practical agriculturists, and to those concerned in the equipment of farms or small holdings.

The object of this article and illustrations is to draw attention to what in effect amounts to a departure from the normal in small holding equipment, and as the main feature, a single span roof covering the whole area of the buildings is much in accord with modern American practice on large farms, it is hoped that criticisms and suggestions will be forthcoming and that practical farmers will express their views on the general principle involved.

In small holding equipment for mixed farming of from 40 to 50 acres there may be said to be two principal types of plan in common use:—

(1) A range of low roofed buildings grouped round three sides of an open space which, by the addition of a fence on the fourth side, becomes the central stock or fold yard. When funds are available this stock yard is covered in by a "space boarded" or corrugated iron roof, which is a separate structure and quite distinct from the roofs over the main buildings.

(2) Two low-roofed ranges of buildings meeting in a right angle, the open stock yard being formed by the addition of an open or closed fence on the two remaining sides.

The actual arrangement of the various parts of the buildings differs slightly according to local custom and climatic conditions, but, broadly speaking, these two types are prevalent all over England and have been the basis of most of the larger holding plans submitted to the Ministry by the County Councils during the past three years under the Land Settlement Act.

The most notable exception to this practice is to be found in some plans submitted by the West Riding County Council in the early part of 1920. The main feature of this design lay in the fact that while more or less following the normal type (1) referred to above, the whole area was intended to be covered in with a single pitched roof which converted the open space in the centre of the quadrangle into a covered stock yard. A model of this plan was submitted by the County Council, the scheme was approved, and seven of these single roof buildings have been erected on the Whixley estate.

Some months ago the writer had an opportunity of inspecting several of the completed and occupied buildings, and was much struck with their obvious efficiency and convenience in general plan and arrangement, and was impressed with the idea that there were possibilities of further improvement and development, in planning and construction, which would minimise both labour in working and the initial cost of the building. It is not suggested that this type is entirely novel in this country. In the Report of the Departmental Committee on the Equipment of Small Holdings, published in 1913, several plans are given which provide for a covered yard which is under the same roof as the remainder of the buildings, but in each case the construction and general layout is markedly different from the plan now under consideration. Fig. 1 shows the West Riding plan as carried out.

It should be stated that these holdings are utilised for mixed farming, that the country is of somewhat high and exposed elevation and cold in winter. The land is of medium texture and a plentiful supply of farmyard manure is imperative. The plan is thoroughly sound in general layout. On the north, adjacent to a hard road, is placed the mixing and storage floor for " roots " with granary over. On the west, with immediate access to the mixing floor are placed the cow house and stalls for fatting beasts. These latter have direct egress into the open without passing through the stock yard. Dunging out can be either into the yard or directly to the open if desired.

Thus so far as this part of the plan is concerned there is simple and direct access from the mixing floor to beasts, cows, and covered yard.

On the east side is placed the cart shed, three-horse stable, and a large utility box which might be used for pigs.

The stable has to be approached for feeding purposes either from the external door on the east side or through the covered stock yard; the cart and implement shed, being placed to the north adjacent to the hard road, cuts off any direct communication from the mixing floor and granary over. This latter arrangement is, I think, open to improvement, and in the plan showing a suggested rearrangement (Fig. 3) the positions of stables and cart shed are reversed.

In the centre is the covered stock yard only 19 feet wide and somewhat long in proportion to its width. The yard is completely enclosed on the south side, but is provided with high and wide doors and ventilating shutter above (see Fig. 2.).

The whole is built of timber very strongly constructed. Heavy oak posts are used to support the roof trusses, which are designed on the Belfast truss principle, perhaps without sufficient regard to the double line of intermediate supports forming the inner walls of the cow house and stable ranges.

The building is lighted by windows in the outside walls and by an ample number of roof lights, and provision is made for continuous roof ventilation on either side of the ridge.

Obviously the questions of choice of materials and method of construction are at present of secondary importance to the question of principle involved by the single span roof over the whole building, which makes the covered yard so essentially an integral part of the scheme.

These particular buildings are constructed of timber mainly on account of the exceptional building difficulties of 1920 and 1921, but there is no practical reason why the outer walls should not be built of stone, brick or concrete, if such materials were available and showed a better economic result. On the other hand, a complete timber construction gives opportunities of standardisation, and the fact that seven such were ordered as one contract must have assisted in reducing the cost of all. The main point to determine is whether a building of this nature, under one roof forming a covered yard in the centre, gives satisfactory results with regard to the health of cows and stock generally, whether it proves economical in time and labour and results in carrying a larger head of stock per holding, together with the production of an adequate quantity of manure.

These are farming questions, and if they can be answered in the affirmative there is no reason why further improvements should not be effected.

It is obvious that the internal arrangements can be modified and amended to suit the exact nature of the land and the holder's requirements without departing from the general principle and without loss of efficiency.

To this end an illustration is given (Fig. 3) showing more direct internal access to the various parts, together with a lighter and more economic form of roof construction. The chief variations from the West Riding scheme are the increased width of the covered yard, which is in Fig. 3 shown as 25 feet instead of 19 feet, the provision of a feeding passage between the mixing floor and covered yard whereby more direct and distributed access is given to the long trough in the yard, and direct internal access from the mixing floor to every part of the building, includ-

Fig. 1.—The West Riding Standard Homestead.

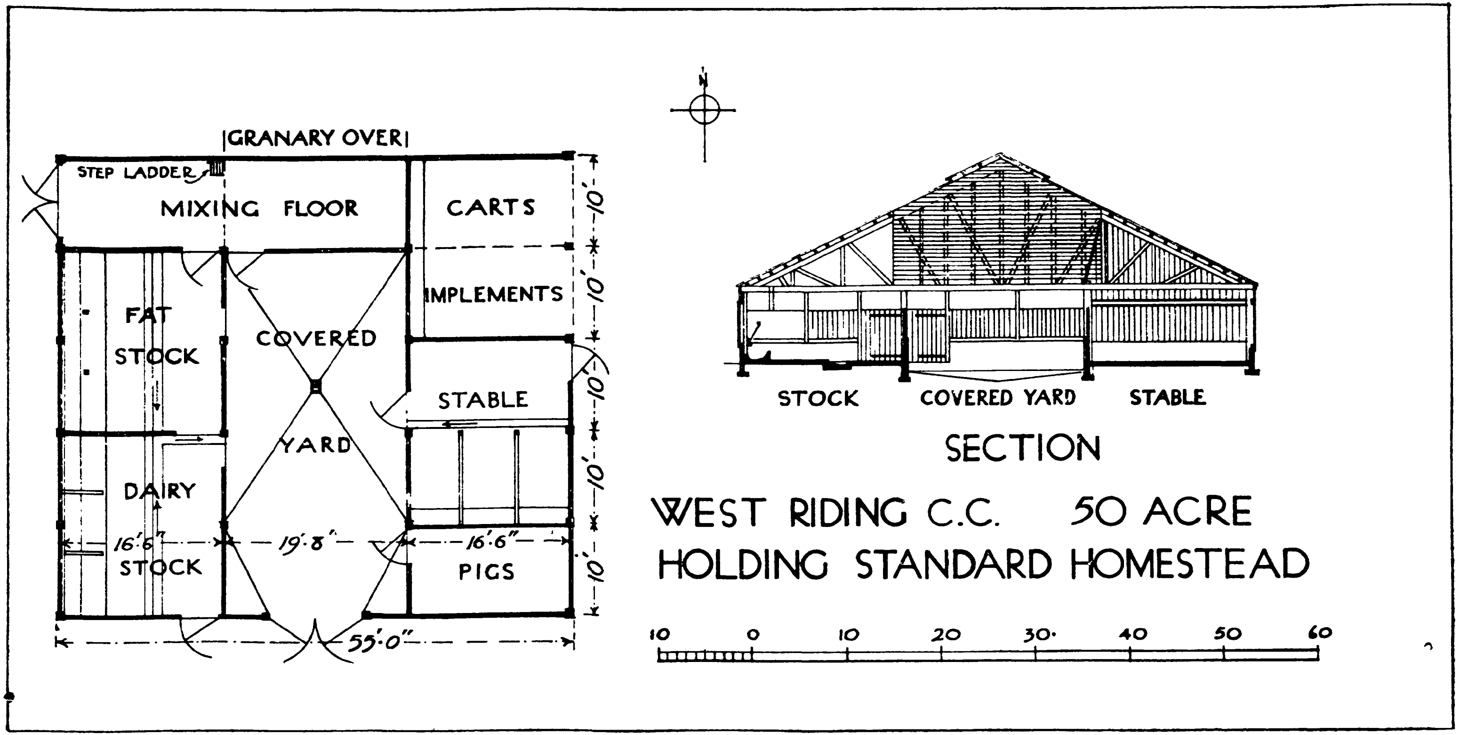
GRANARY OVER
STEP LADDER
MIXING FLOOR
CARTS
IMPLEMENTS
FAT STOCK
COVERED YARD
STABLE
DAIRY
STOCK
PIGS
16'6"
19'8"
16'6"
55'0"
10'
10'
10'
10'
10'
N
STOCK
COVERED YARD
STABLE
SECTION
WEST RIDING C.C. 50 ACRE
HOLDING STANDARD HOMESTEAD
10
0
10
20
30
40
50
60

Fig. 2.

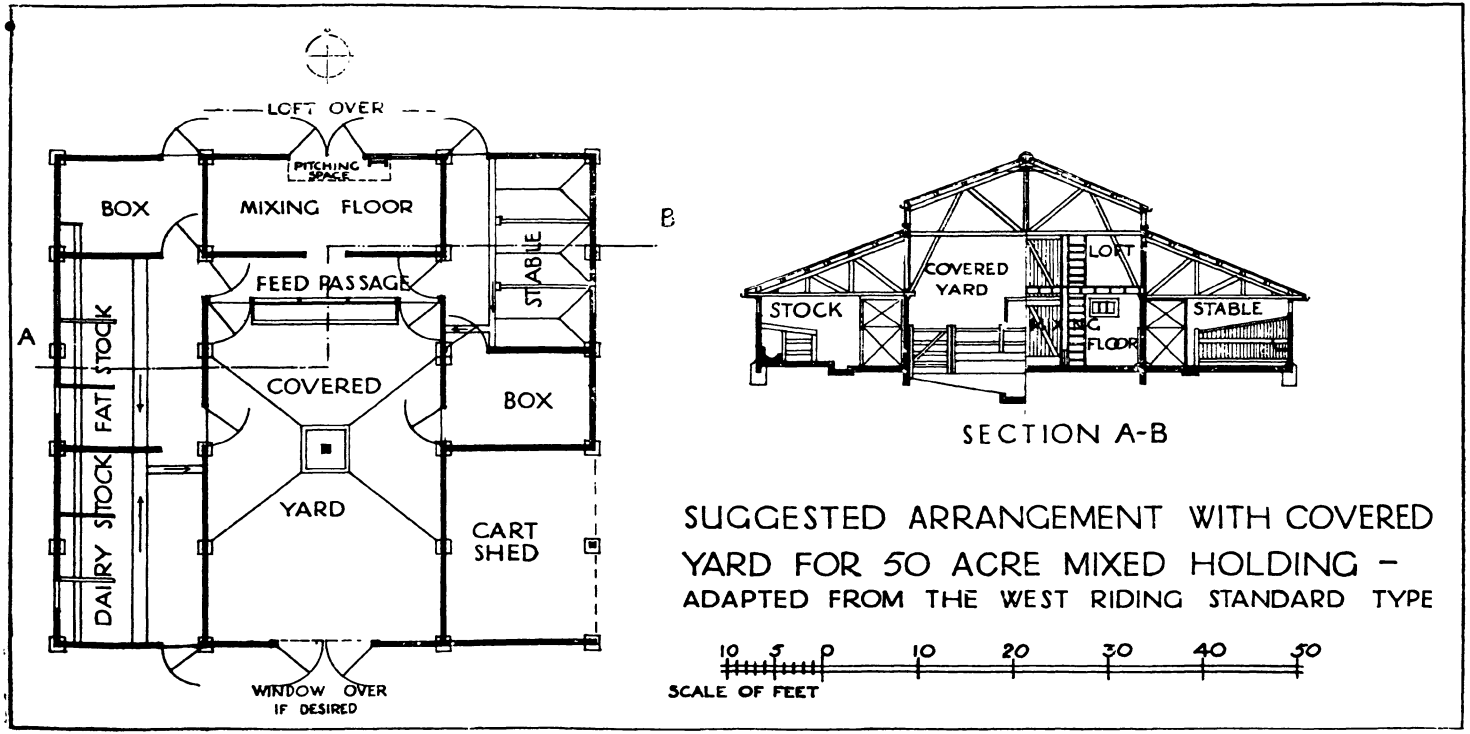
LOFT OVER
PITCHING SPACE
BOX
MIXING FLOOR
FEED PASSAGE
STABLE
A
B
FAT STOCK
DAIRY STOCK
COVERED
YARD
BOX
CART SHED
WINDOW OVER IF DESIRED
STOCK
COVERED YARD
LOFT
MIXING FLOOR
STABLE
SECTION A-B
SUGGESTED ARRANGEMENT WITH COVERED YARD FOR 50 ACRE MIXED HOLDING – ADAPTED FROM THE WEST RIDING STANDARD TYPE
10 5 0 10 20 30 40 50
SCALE OF FEET

FIG. 3.

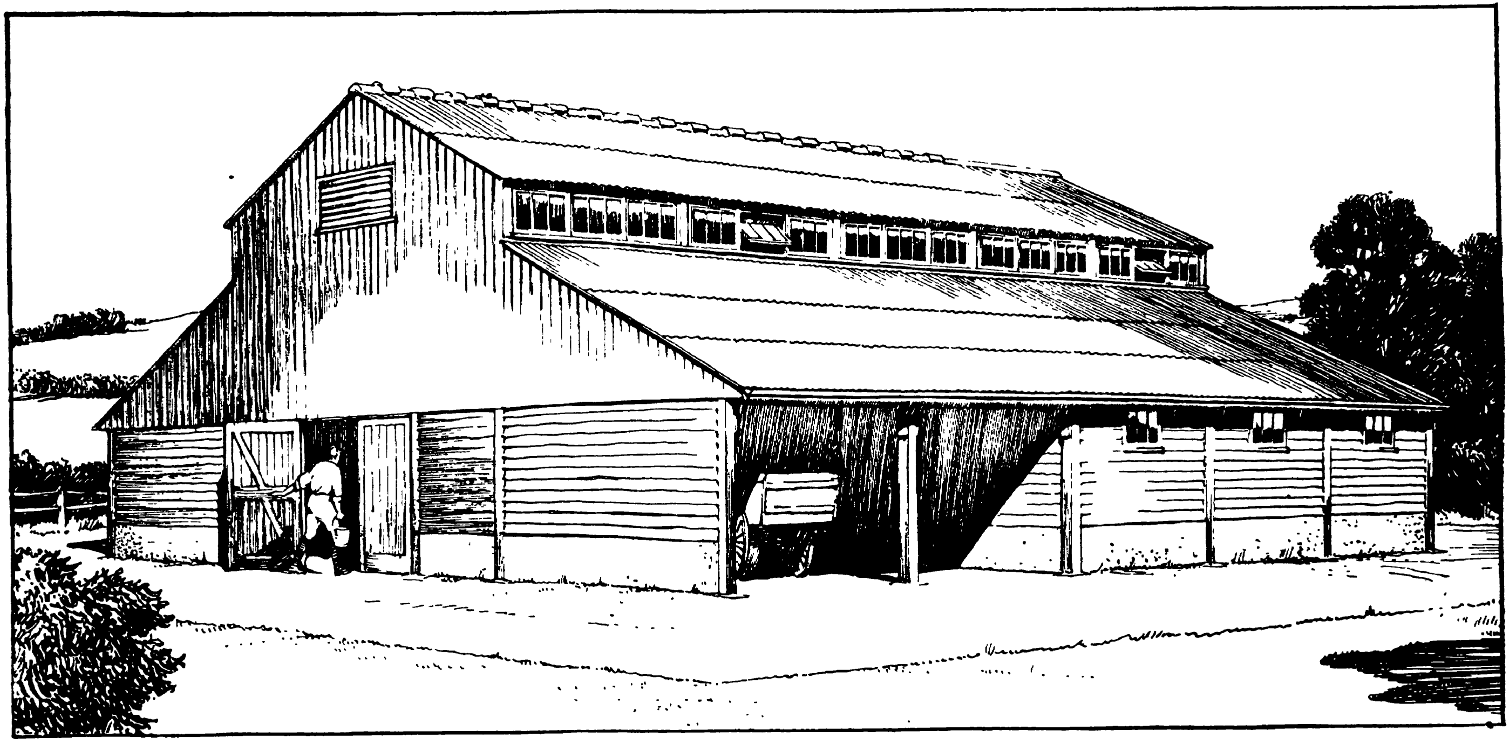

FIG. 4.—General View of the Building adapted from the West Riding Standard Type.

ing the stable, which, as before stated, has changed positions with the cart shed. It should be noted that there is also external access to all stalls and boxes, and direct internal access to the covered yard for dunging out.

The construction is somewhat different from the West Riding Scheme, and is similar in principle to the construction designed for the Ministry's Arable Dairy Farm Cowshed at Hucknall, which it is intended to deal with in a future number of this *Journal*. It is more simple in design, and in place of roof skylights a continuous range of vertical lights is shown on each side of the roof. No special advantage is claimed for this method of lighting, and in practice it would probably resolve itself into a question of cost balanced against the relative merits of the two systems as regards annual upkeep.

A Comparison of Costs.—The question of the relative cost of covering in a quadrangular building with a single span roof or of roofing the three ranges with small span roof and leaving the centre space open, is somewhat difficult to determine without actual estimates, but the following figures are instructive:—

The cubical content of the West Riding building as carried out are approximately 45,800 cubic feet and the roof area is 3,160 square feet. If the yard is left open and the surrounding three ranges are covered with a 30 degrees pitch roof, excluding the yard, the cube is only 22,150 cubic feet, but the roof area is 2,520 square feet, a difference of nearly 50 per cent. in the cubic contents, but only 20 per cent. difference in the actual amount of roofing.

In addition, with the single roof a considerable saving would be effected on rain-water spouting, down pipes and drains, and the three exterior walls enclosing the yard become interior walls under the span roof, and thus there should be less annual maintenance.

Probably the extra cost of the single span roof with its many advantages and the greater centre space would not exceed 10 per cent. to 15 per cent., and might under favourable circumstances be even less.

Conclusion.—It is probably too early to form a decided opinion as to the ultimate results of this departure from accepted normal type, but if the building enables the small holder to carry more stock and obtain better results, then there is every reason to elaborate this type of building for larger sized holdings and its future development will largely depend upon the amount of prac-

tical information which can be derived from a study of the actual holdings in working occupation. In any event the Small Holdings Committee of the West Riding and their architect, Mr. Foster, are to be congratulated upon their originality in producing a building of such merit, and may feel assured that the progress of the experiment will be watched with the utmost keenness by all those who believe that finality in farm planning has by no means yet been reached in this country.

* * * * * *

GERMINATION OF INDIGENOUS GRASS AND CLOVER SEEDS.

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IN a prevous article in the *Journal** the present writer drew attention to the probable usefulness of strains of indigenous herbage plants for use in the preparation of temporary and permanent grass.

This matter was under consideration at the Food Production Department in 1917-18, when with the assistance of numerous interested persons a considerable amount of seed of various species was collected.† During the past three years much additional seed has been obtained in connection with the work now in progress at Aberystwyth. It is not proposed to deal here with the evidence that has now been accumulated as to the undoubted merit of indigenous strains of many of the grasses,‡ but it is only the purpose of this article to compare the germinating capacity and other characteristics of seed collected from plants growing in their natural habitats, on one hand with seed grown and harvested at Aberystwyth, and on the other hand with ordinary commercial samples. In certain cases it is also possible to give some idea of the amount of seed that may be collected per person per unit of time. The yields obtained from plots producing "once grown" seed are not here discussed. The necessary tests on seed collected during

* See "The Temporary Ley": This *Journal*, February, 1919, p. 1280.

† See "Plant Breeding Work at Aberystwyth," *ibid* October, 1920, for acknowledgment to those who then rendered assistance.

‡ See "Preliminary Investigations with Herbage Plants," Welsh Plant Breeding Station, Aberystwyth, Bull. H.1. for particulars of quantitative trials so far conducted.

1917-18 were conducted at the Official Seed Testing Station (then at the Food Production Department) while those on samples collected subsequently have been made by similar methods at Aberystwyth.

It will be convenient to deal with the species that have been collected under separate headings: "Legumes," "Grasses" and "Miscellaneous Plants."

Legumes.—The figures in Table I give particulars relative to indigenous legumes and where possible figures for ordinary commercial samples have been included in the table for the purpose of comparison.

TABLE I.—Percentage Germination, Hard Seed, and Weight per 1,000 Seeds in the case of Indigenous Legumes collected from various native habitats. When possible, comparisons are made with Commercial samples.

Species	No. of Lots	INDIGENOUS					COMMERCIAL		
		Average Germination	Highest and Lowest germination	Average Hard Seed	Highest per cent. Hard Seed	Weight per 1,000 in gr.	Average Germination	Average Hard Seed	Weight per 1,000 in gr.
Wild White Clover	9	28	74-12	47	82	·49	77·3	12·7	*6 & 7†
Wild Red Clover	7	52	100-11	32	87	1·49	81·7‡	4·7‡	‡1·9
Bird's Foot Trefoil	3	26	37-15	48	58	—	70	17	—
Trefoil	3	39	—	50	65	1·68	79·8	2·7	1·8
Tufted Vetch ...	3	3	7-0	65	99	—	—	—	—
Meadow Vetchling	2	12	25-0	79	100	—	—	—	—

* Commercial Wild White. † Commercial White Dutch.
‡ English Grown Ordinary Commercial Red Clover.

The result of the tests bring out very prominently the high percentages of hard seed that are to be met with amongst legumes and which show themselves in the germination test when the seed has not been subjected to any rasping process.* It is interesting to observe that hard seed is by no means confined to red and white clover but is equally in evidence in the case of the wild vetches and bird's-foot trefoil—whilst trefoil, one of the "softest" seeds after being subjected to the hulling and cleaning processes, is exceedingly hard when collected by hand and tested without any pre-treatment.

It has been noted, moreover, that hardness appears to be at its maximum in the case of samples harvested late and when the seed has fully matured. The poor average germination

* Hardness can be greatly reduced by rubbing the seed with sand paper or on a smooth surface with a bath brick or by shaking violently in a box lined with sand paper.

given by the indigenous legumes is therefore seen to be chiefly due to excess of hard seed and not so much to poor viability.

The evidence suggests that on the average the grain weight (wt. in gr. per 1,000 seeds) of the indigenous seed tends to be less than that of their commercial counterparts. It has to be remembered, however, that the collected seed had not been cleaned or dressed and that the grain weight has been the "natural" weight. It is, however, a well-known fact that even commercial samples of wild white clover have decidedly lower grain weights than samples of commercial white or Dutch Clover. Comparison between samples of wild red clover and of ordinary English grown red clover show moreover that the wild red seldom contains many seeds as large as the larger of those met with in the cultivated clovers.

The collection of indigenous legumes is a very slow and tedious process. This is particularly so in the case of the wild vetches, which do not as a rule grow in large masses and the individual plants of which appear to be rather poor seed bearers, ripening their seed moreover irregularly over a somewhat long period.

The collection of wild white clover by hand is certainly not lightly to be undertaken, and the heads collected often yield most disappointing crops of seed.* The hand collection of wild red clover is even more tedious than of wild white—for it is not so frequently met with in large masses. Both are species that in the writer's opinion could only be remuneratively harvested from old swards on which they are abundant, and then only by resort to the reaper or to the scythe or possibly the daisy rake.†

Grasses.—Particulars with reference to the grasses are given in Table II. All the germination figures have been arrived at on the basis of including "light" seed with the pure seed for the germination test.‡ In order to make the comparisons more thorough the percentage of "heavy" seed is given in the case of those species in samples of which "light" seed is frequently

* Mr. H. H. Dunn, of Dunn's Farm Seeds Ltd., informs me that 4 bush. of heads have in one case yielded no more than ¾ lb. seed—while it is said that under favourable circumstances 20 lb. of heads will yield 1 lb. of seed.

† The writer is not enamoured of the daisy rake as a very helpful implement, although he is prepared to admit he may be prejudiced against it by his own lack of skill in its use, but even in the hands of a practical gardener the results did not appear particularly encouraging.

‡ That is to say, the plan of testing that was adopted at the Food Production Department, and is still adopted at the Seed Testing Station of the Department of Agriculture and Technical Instruction for Ireland, has been followed.

abundant. The grain weight (wt. per 1,000 seed) has in all cases been taken on "heavy" seed and not on the sample as a whole. This plan has been adopted in view of the fact that the indigenous seed both collected and "once grown" has not been well cleaned or in any way dressed, thus a "heavy" seed grain weight gives a more accurate comparison between indigenous (collected and "once grown") and commercial than a grain weight based on the weight of 1,000 seeds taken from a sample before removing the "light" seed. The grain weight figures given for commercial samples are of necessity based on special tests made at Aberystwyth and have been obtained for the most part on high-grade seed which has been used in connection with the nationality trials conducted at the Plant Breeding Station.*

It will be seen that the germination of the indigenous grasses collected from various habitats is in the main very low—the average of all the samples together being only about 50 per cent. Individual samples, however, gave high figures; this was particularly so in the case of Timothy and crested dogstail. The low germination is very largely due to the considerable amount of light seed present, which in all cases averages more than that found in commercial samples. The germination of heavy seed was, however, also found to be lower than that of heavy commercial seed. One reason, and perhaps the chief reason of the relatively poorer germination of collected than of commercial seed, is undoubtedly the result of greater injury by the grubs of various insects. This was particularly marked in the case of cocksfoot—the seed of which suffered in a marked degree from attacks by the larvæ of *Glyphipteryx fischeriella*. The attack was greatest on plants growing in thickets and relatively shaded places. Meadow foxtail showed

* The average figures given in the first, second and third Annual Reports of the Official Seed Testing Station are not generally applicable to the comparisons here made, for the reason that grain weight, percentage of heavy seed and germination figures for the different nationalities of the grasses are not recorded. Average figures from the reports in respect of germination have however in some cases been drawn upon; the reports in question should be referred to: See First Annual Report in this *Journal*, Vol. XXV (6), September, 1918, Second Annual Report, *ibid.* Vol. XXVI (9), December, 1919, and Third Annual Report, *ibid.*, Supplement No. 20. The majority of the Aberystwyth tests have been made specially in connection with the work under review; results previously recorded have, however, also been drawn upon, see, *e.g.*, Stapledon, "Seed Studies," *Journal Agricultural Science*, Vol. X (1), June, 1920, and report on the "Condition of the Seed Trade in the Aberystwyth College area"—Univ. Coll. of Wales, Aberystwyth, *Bulletin*,—February, 1914. Results of tests made by Jenkin (see "Seed Testing and Report on Seeds Tested 1913"; Univ. Coll. of N. Wales, Bangor, Bulletin) have also been drawn upon in arriving at some of the average figures.

considerable injury due to Thrips (*Thrips cerealium*),* while tall fescue was also attacked by a grub not yet identified. These attacks were responsible for a failure of much of the heavy seed to germinate and also gave rise to much light seed and impurity.†

Another factor influencing the poor quality of collected seed is probably connected with the variable nature of any particular habitat from which seed is collected. Seed collected in bulk from hedges will be taken from numerous sub-habitats—from the top, bottom and different sides of a hedge, while from thickets there will be every degree of exposure to light and shade. Thus it is impossible to collect any considerable quantity of seed all under reasonably identical conditions of growth and harvest, and still less under the best conditions. This may be achieved with fair success in the case of plants growing in large masses together. Thus perennial rye grass growing in relatively large practically pure association near the Harbour at Aberystwyth and harvested when nicely ripe gave a germination of 88 per cent., while a lot of 5½ lb. of cocksfoot collected from the top of a long hedge germinated 54 per cent., compared with a lot of 7 lb. collected from a thicket germinating 44 per cent. and with a 3 lb. lot from another thicket germinating only 12 per cent. Individual panicles and small bunches of panicles were, however, selected from numerous habitats, the seed of which germinated over 80 per cent. Crested dogstail collected off old permanent pastures with a southern aspect has given attractive bright samples germinating over 90 per cent.

The "once grown" seed at Aberystwyth under uniform garden and field conditions has on the average germinated better, and in practically all cases has given considerably more heavy seed than the collected, and this despite the very unfavourable harvest conditions of 1920.

It is of interest to note in this connection that "once grown" cocksfoot was less severely attacked by the larvæ of *Glyphipteryx fischeriella* than the collected.

A comparison of the grain weight of heavy indigenous seed with that of heavy commercial seed, as with the legumes, shows the advantage as to weight to be considerably in favour of the commercial. The only exception is meadow foxtail, in the case of which, however, only very inferior commercial samples

* See "Preliminary Investigations with Herbage Plants," *loc. sit.*

† Single husks and chaff.

came under test. It will be seen that in the main there is fair agreement between the grain weights of collected and "once grown" indigenous seed having regard to the fact that only comparatively few of the collected samples were "once grown." Thus in the case of cocksfoot where a comparatively large number of lots were tested it seems quite evident that the indigenous types give rise to decidedly lighter "heavy" seed than the Danish and U.S.A., but that the New Zealand approaches more nearly to the indigenous.*

Even under the most favourable conditions, for instance, species growing in relatively large pure closed associations, the collection of indigenous grass seed for the purpose of sowing direct in mixtures would probably be too tedious and costly to be adopted, while the collection of seed from scattered plants (*e.g*,, tall fescue) would be quite out of the question. Fair quantities of seed can none the less be harvested by persons with sickles from cocksfoot growing, for instance, on hedge tops or in thickets. Thus the writer and three other adults collected heads which thrashed and winnowed down to 1 lb. 4 oz. of seed per person per hour from a thicket where cocksfoot was growing particularly abundantly, and 7 oz. of seed per person per hour from hedges where the same grass was exceptionally abundant. In the former case it was possible to cut the seed almost continuously, while in the latter considerable blank distances had to be covered. It should be remarked that reduced to weight of viable seed per person per hour the thickest harvest represented but little over ½ lb. and the hedge only 3¾ oz. Children with pocket knives even from a thicket where cocksfoot was very plentiful did not collect more than ¼ lb. of dressed seed (not adjusted for viability) per child per hour.

The collection of meadow foxtail which ripens very irregularly represents considerably more labour per lb. of viable seed, while the hand collection of crested dogstail by children, even on pastures where exceptionally plentiful, is a very slow process.

Miscellaneous Plants.—Yarrow is frequently plentiful on railway embankments and other waste places where fair quantities of seed may be collected. Four samples thus collected gave an average germination of 72 per cent. with a range of 96 per cent. to 26 per cent.

* This is interesting in view of the differences in growth habit that have been noted as between Danish and U.S.A., on the one hand, and indigenous and New Zealand on the other—see "Preliminary Investigations with Herbage Plants," *loc. cit.*

Summary and Conclusions.—It has been shown that the seed of indigenous species collected from various habitats tends on the average to be of poor germinating capacity, and that this is in part at all events due to the ravages of various insects, and in part to the difficulty of harvesting large quantities of seed under suitable and similar conditions. "Once grown" seed appears to be less attacked by insects and to germinate more satisfactorily. It has been shown also that the collection of indigenous seed is a slow and laborious process.

The amount of labour involved is, however, not excessive if it were only desired to collect indigenous seed for the purpose of obtaining a supply for inclusion in mixtures by the process of "once growing."

The precise value of "once grown" bulk collected seed* of such important grasses as perennial ryegrass, cocksfoot, timothy, meadow foxtail and the like can only be definitely settled by further investigation. With the lesson of wild white clover before the agriculturist it would seem that he may reasonably expect good results from the inclusion of such "once grown" seed in mixtures designed for the preparation of long duration and permanent grass. The trials so far conducted at Aberystwyth tend to show that indigenous cocksfoot, ryegrass and timothy, for instance, have important qualities for long-duration pastures and are undoubtedly more persistent than their commercial counterparts.†

The growing of grasses for seed production would not entail much labour—it would be necessary to keep the land scrupulously clean; this may be achieved by growing in drills and by scuffling and hand hoeing. Provided weeds were absent, a highly dressed sample for the purpose of sowing would of course be quite unnecessary.

It is suggested, therefore, that apart altogether from results that may finally be achieved by processes of breeding and selection, the question of the growing of bulk collected seed of indigenous grasses is one demanding considerable experimentation and one that should be considered as possibly an economic practice by those farmers who contemplate seeding considerable areas to long duration and permanent grass.

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* *i.e.*, seed collected without any selection from grasses growing in fairly large masses together.

† See "Preliminary Investigations with Herbage Plants," *loc. cit.*

TABLE II.—Comparison of the germination and other characteristics of the seed of indigenous grasses when collected from various natural habitats with those of "once grown" at Aberystwyth and ordinary commercial seed.

Species.	Collected Indigenous or Purchased Commercial.						"Once Grown" at Aberystwyth.				Remarks.
	No. of Samples	Per cent. Germination	Range	Per cent. Heavy Seed	Range	Grain wt. (= wt. 1,000 seed in gr.)	No. of lots	Per cent. Germination	Per cent. Heavy Seed	Grain wt. (= wt. 1,000 seed in gr.)	
COCKSFOOT.											
Indigenous from eleven Counties in England and Wales... ...	53	50	85-6	65	98-6	·85	5 1	*62 ‡75	75 93	·78 ·84	Majority of collected samples badly attacked by grubs and many ergotted.
Danish and U.S.A.	8	88	—	92	—	1·06	12 4	*78 ‡92	86 95	1·14 1·24	
New Zealand	9	70	—	86	—	·89	1	‡76	92	·95	New Zealand and Indigenous "once grown" appreciably attacked by grubs.
MEADOW FOXTAIL.											
Indigenous from six Counties in England and Wales	14	28	66-8	60	76-22	1·31	30	*60	74	·95	Several of the collected samples considerably attacked by grubs.
Commercial	5	40	—	79	—	·93	—	—	—	—	
TALL FESCUE.											
Indigenous from four Counties in England and Wales	7	30	87-3	45	74-8	1·11	—	—	—	—	Several of the collected samples badly ergotted.
Commercial	†	60	—	—	—	2·2	—	—	—	—	
TALL OAT GRASS.											
Indigenous from two Counties in England and Wales	6	54	56-37	—	—	2·2	—	—	—	—	
Commercial	†	69	—	—	—	3·0	—	—	—	—	
TIMOTHY.											
Indigenous from five Counties in England and Wales	7	81	97-71	—	—	0·28	2	*85	—	·31	
Commercial	†	87	—	—	—	0·40	1	‡94	—	·32	
PERENNIAL RYE GRASS.											
Indigenous from Cardiganshire...	4	73	76-62	90	96-86	1·42	2	‡97	99	2·00	
Commercial	†	80	—	96	—	2·25	1	‡97	99	2·10	
CRESTED DOGSTAIL.											
Indigenous from seven Counties in England and Wales	17	59	98-8	—	—	·44	6	*12	—	·43	
Commercial	†	68	—	—	—	·53	*5	*55	—	·45	

† Average figures from various reports, see foot-note p. 121, and from tests made at Aberystwyth. * Harvest of 1920. ‡ Harvest of 1921.

CROPPING OF A DERELICT ESTATE IN SUSSEX.

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THE name Peacehaven has been given to a tract of land originally forming part of Hoddern Farm, Piddinghoe, lying between Newhaven and Brighton in the very heart of the South Downs. The greater part of this estate was taken possession of and farmed by the East Sussex Agricultural Executive Committee in May, 1917, and other parts at later dates.

The soil is extremely variable as, although resting on the South Downs, a considerable portion of it, probably some 300 acres, consists of an extremely light, poor sand, an almost equal area consists of the thin chalky loam so common on the South Downs, and at one place there is a "clay pocket" where the soil is extremely heavy and "unkind."

Previous Method of Farming.—Before 1915 the land was farmed according to the usual South Down practice, but as it had been for some years in the market, and was eventually sold for building purposes, it cannot be said that it had been cultivated in such a way as to leave any appreciable amount of residual fertility.

For about 20 years a flock of South Down sheep had been kept, and the system of farming seems to have depended entirely on the flock, but towards the latter part of this period, as dairying spread in East Sussex, cows were also kept.

For a considerable period no fertilisers of any description were used on this farm, and, as it had probably been "sheeped" for centuries, there is no doubt that the soil, like so much other poor hill land, had been "sheeped out" or depleted of all available phosphates.

Season 1916.—During the season 1916, practically no farming was carried out on the land, and the Committee were informed that the produce from the greater part of the land was actually sold for £100, so that the quantity of food produced from it in 1916 was practically negligible.

Season 1917.—In January, 1917, two of the best known surveyors in Sussex described the land as derelict.

The Committee made every effort to arrange for the cultivation of this land but it soon became apparent to them that, if

it was to produce anything like the amount of food that it was capable of doing, the management and work would have to be carried out under their direction. Consequently, in May, 1917, they commenced operations, but under exceptional difficulties.

Buildings, Implements, etc.—The farm-house and buildings which had previously gone with the land had been sold separately, and it was, therefore, necessary for the Committee, whilst erecting temporary galvanised buildings, to hire stabling. The Committee had neither horses, implements nor men, but one of the earliest tractors to be supplied under the Food Production Department's scheme was sent to Peacehaven. This was of the caterpillar type, unwieldy and powerful, but very effective in tearing through the weed and other growth which had accumulated since the autumn of 1915. Subsequently a set of steam tackle was hired by the Committee and proved very helpful in cultivating the land after it had been ploughed once, but it was found that, owing to the rubbish which had accumulated, this tackle was not very effective for ploughing.

Labour, Horses, etc.—In the early summer of 1917 a number of Metropolitan Police (many of whom had previously been Sussex ploughmen) were drafted into the county, and four of them were selected and sent by the Committee to Peacehaven, whilst in June, 1917, the Food Production Department inaugurated their scheme for supplying horses, and eight were sent in charge of the Metropolitan Police to Peacehaven.

Fallowing Operations.—During the summer of 1917, 164 acres of land were thoroughly fallowed, and prepared for wheat, although the summer was not one of the best for fallowing operations owing to the somewhat exceptional rainfall for the district.

Fertilisers Used.—It was known from the previous history of the farm and the farming, together with the nature of the soil and the surrounding land, that, if satisfactory crops were to be grown, the soil must be supplied with suitable fertilisers. All the land sown with wheat (164 acres) was therefore dressed with 5 cwt. per acre of a good grade basic slag. As the work was not carried out for an experimental purpose no part was intentionally left without its dressing, but, in one place, where the manure distributor broke and consequently the slag was not applied, the omission could be plainly seen for several months.

Season 1918.—In the spring of 1918 all the wheat was dressed with 1 cwt. of sulphate of ammonia per acre. The

combination of the basic slag applied in the previous autumn with the sulphate of ammonia in the spring was most effective, as may be gathered from the fact that the 164 *acres of " hill " land averaged 44 bus. of wheat to the acre.*

Varieties of Wheat.—The varieties of wheat grown were " Garton's Victor " and " Little Joss," both of which were supplied by the Food Production Department and gave excellent results on this land. It is probable that the " Garton's Victor " yielded slightly better than the " Little Joss," but on the other hand, with a large acreage of wheat, it was considered that " Little Joss " could be sown more safely at a later period in the year than could " Garton's Victor."

In addition to the wheat, 225 acres were sown with oats. The oats produced an average crop but not comparable with the results obtained from the wheat.

Harvesting.—The Committee had exceptional difficulties in dealing with the harvest in 1918, as labour was scarcely obtainable. Further, there was not even a barn suitable for even temporarily accommodating labour or storing corn. Newhaven, the nearest town, was closed for military reasons, so that for the harvesting operations the Committee had to rely very largely on German prisoners supplied from Lewes—a distance of 6 miles. These had to be sent by lorry in the morning and fetched at night.

Season 1919.—Although the yield of wheat during the first season was so heavy it was generally thought by farmers in the district that it would not be possible, on this poor land, to grow a remunerative crop during the following season. As, however, this was an attempt to produce the greatest amount of wheat possible, during the following season the greater part of the acreage previously under wheat was again sown with wheat, together with an additional acreage, making in all 262 acres.

The same varieties of wheat were again grown, viz., " Garton's Victor," and " Little Joss," whilst, in addition, 19 acres were sown with " Yeoman " wheat.

Fertilisers Used in 1919.—It was not possible to obtain a high-grade basic slag, but only one of a very low quality, viz., 20 per cent. total phosphates, so that on the average approximately 7 cwt. of this slag were applied per acre to all the wheat land. In the spring of the year the land which had previously been cropped with wheat, was dressed with a mixture

FIG. 1.—Crop of Wheat, 1919.

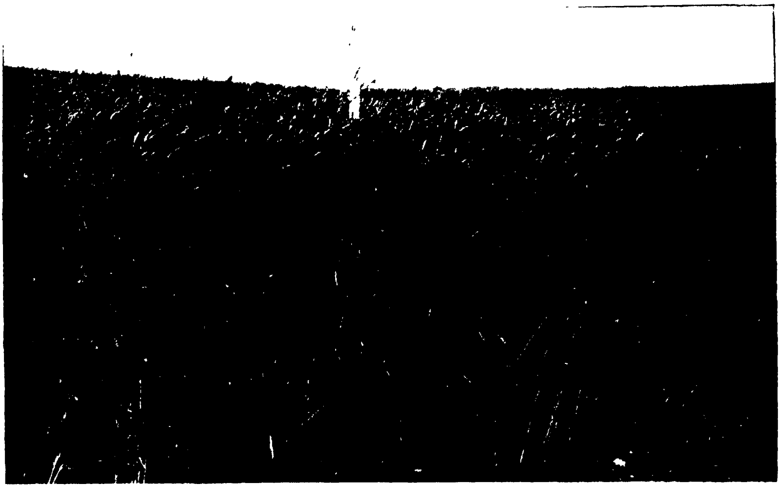

FIG. 2.—Crop of Little Joss, 1920.

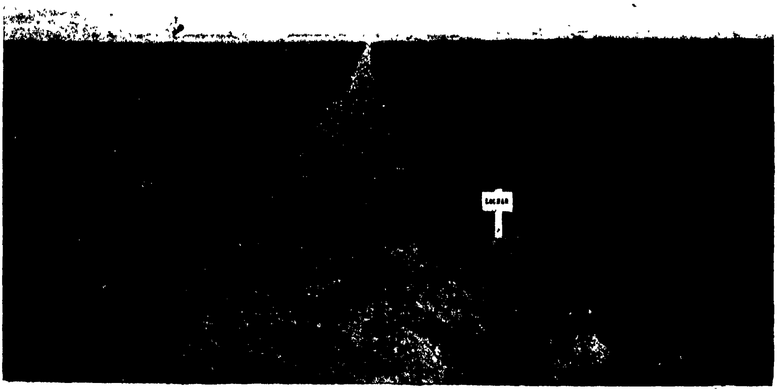

FIG. 3.—Field of Potatoes in 1919.

of 2 cwt. of sulphate of ammonia and 2 cwt. of superphosphate per acre.

Harvesting in 1919.—In the harvesting operations of this crop tractors were very largely used. All the binders were drawn by tractors. It was found that the most satisfactory plan was for a " Titan " to precede a " Fordson," as this tended to keep the driver of the latter tractor steadier than if left to his own devices.

The total amount of wheat grown in 1919 amounted to 2,409 sacks—an average of over 36 bushels per acre on the total acreage. Fig. 1 shows the crop.

Wheat after Wheat.—One reason for growing this large acreage of wheat after wheat was that, in common with most of the land on the Sussex Downs, spring crops are much impeded by the prolific growth of charlock. It is, of course, recognised that this weed can be combated by spraying, but spring crops on the Downs are very susceptible to checks of any kind.

In 1919, again, the oats grown were an average crop for the district but not more. This was due to the very light rainfall in 1919, the competition of the charlock, and to the fact that, owing to the scanty rainfall the spring corn could not avail itself of the fertilisers as did the longer growing and deeper rooted wheat crop.

Potatoes. — In 1919 potatoes were introduced into the cropping. In all about 20 acres were grown. Local opinion was again discouraging to such an experiment, as it was stated that the soil was so light that it would be blown away. The results, however, were most gratifying (Fig. 3).

Scotch seed potatoes were obtained. These were manured with approximately 5 cwt. of flue dust, 6 cwt. of superphosphate and 2½ cwt. of sulphate of ammonia per acre. A quantity of the earliest dug potatoes were sold in Brighton at £13 per ton, but the remainder were sold at a lower rate when the price was controlled.

Further, as the seed had been obtained direct from Scotland no difficulty was experienced in obtaining a ready sale for the smaller potatoes as seed potatoes—" once grown " from Scotland.

Season 1920.—Having regard to the excellent crops of wheat which had been grown in 1918 and 1919, and to the fact that the autumn sown wheat was so much more successful than the

spring sown oats, approximately the same acreage was again sown with wheat in the autumn of 1919.

Much the same type of manuring was again carried out as in 1919, viz., approximately 7 cwt. of low-grade basic slag per acre, and, owing to the better facilities for obtaining nitrate of soda, the spring dressing of wheat generally consisted of 1 cwt. of sulphate of ammonia and 1 cwt. of nitrate of soda.

About 70 acres of "Yeoman" wheat were grown in this season, the remainder again being "Garton's Victor" and "Little Joss."

There was again promise of a successful harvest, and this was borne out by an average yield of 33 bushels per acre (Fig. 2).

Extension of Potato Acreage in 1920.—A larger acreage of potatoes was grown in 1920, in all nearly 100 acres.

The varieties grown were chiefly "Arran Chief" and "Lochar" as these were considered to be the two varieties which had given the best results in the previous year. The greater part of this acreage was manured with 6 cwt. of superphosphate, 1 cwt. of sulphate of potash, and 3 cwt. of sulphate of ammonia per acre. Some part, however, received kainit and steamed bone flour, instead of sulphate of potash and superphosphate.

The best area of Lochar averaged over 13 tons per acre, and the best of the Arran Chief slightly under 12 tons, although this high average was, of course, not maintained over the whole acreage.

Nearly all the potatoes found a ready sale in Brighton and were of excellent cooking quality—a quality in no small way due to the very sandy soil.

Despite the prevalence of potato disease in this district, the potatoes kept remarkably healthy and free from disease. Spraying probably did not pay in 1919, but in 1920 it undoubtedly doubled the crop. Spraying was commenced early in June, and continued until the potatoes began to ripen off.

Spring Corn in 1920.—The spring-sown crops in 1920 were much better than in the two previous years. This was due to the exceptionally heavy rainfall in April which so materially benefited the spring crops on the Sussex Downs.

The question has frequently been asked as to how long this system of farming could be maintained on such poor and impoverished land, without stock. The writer thinks that, with suitable modifications, it could have been continued almost indefinitely.

Continuous cropping with wheat must of course be regarded purely as war-time farming and as an endeavour to produce the greatest quantity of wheat possible.

The success of the crops was undoubtedly due to the recognition of the fact that this land, like so much other land on the hills in Sussex is, or was, almost deficient in available phosphates, and that the fertility could only be restored by the liberal application of phosphates in conjunction with a nitrogenous fertiliser.

Although the value of basic slag on grassland has been widely appreciated locally, very few realise its importance on cereal crops on this hill land which is so markedly deficient in phosphates.

During the three years that this land was farmed by the East Sussex Agricultural Executive Committee, the receipts from sales of crops grown exceeded £22,000. The crops consisted chiefly of wheat and potatoes, so essential during that critical time as producing the greatest amount of human food per acre.

DEPTH OF SOWING GRASS AND CLOVER SEEDS.

PART II.

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White Clover.—In spite of the high percentage of surface seedlings given by the surface sowings—67 per cent. for the pots and 75 per cent. for boxes—these sowings must be regarded as failures on account of the stunted nature of many of the seedlings. The best results were obtained when the seeds were lightly covered.

In the box experiment the best results were given by $\frac{3}{8}$ in., $\frac{1}{2}$ in. and $\frac{1}{4}$ in. depths; in the pot experiment $\frac{1}{8}$ in., closely followed by $\frac{1}{4}$ in. and $\frac{3}{8}$ in. gave the greatest number of surface seedlings. The $\frac{3}{4}$ in. depth was only slightly inferior to the shallower coverings, while the 1 in. depth in the pot experiment gave about the same number as the shallower depths; but in the box experiment which approximated more closely to field conditions the number of seedlings that reached the surface from 1 in. dropped to 66 per cent. as compared with 92 per cent. from $\frac{3}{8}$ of an inch. When covered to depths of 2 and 3 in. hardly any of the seedlings were able to break through to the surface.

Not only did the shallower depths ($\frac{1}{8}$ in. to $\frac{3}{4}$ in.) give higher percentages of surface seedlings but the seedlings also reached the surface sooner and more regularly; consequently the growth was more even than at the $\frac{3}{4}$ in. to 3 in. depths. When covered to 2 or 3 in. depths the seedlings were very slender when they reached the surface, and remained etiolated for quite a considerable period.

White clover seedlings closely resemble red clover seedlings in form and general habit, but as the radicles are not so stout and the tips not so blunt they are able to penetrate the surface with greater ease than red clover seedlings. But as in the case of surface sown red clover seeds, a considerable portion of the radicle remains exposed on the surface even after the seedlings have become fixed.

When covered, white clover seedlings (with their smaller cotyledon leaves) are able to force their way through fairly light coverings with greater ease than the seedlings of red clover, thus when sown at half an inch 95 per cent. of the white clover

seedlings as compared with only 74 per cent. of the red clover seedlings reached the surface in 10 days after sowing; but when sown at depths of 2 and 3 in. this advantage was more than counterbalanced by the smaller amount of reserve food material contained in the cotyledons of white clovers. This is the probable explanation for white clover seedlings failing to reach the surface when sown at these depths.

Sowing in Wet Weather.—That a fairly satisfactory "take" can be obtained by merely sowing the seeds broadcast on the surface during a prolonged period of wet weather is shown by the following experiment in which the surface soil of one series of pots was maintained in a thoroughly saturated condition while the other series were given normal watering:—

	Saturated.	*Normal watering.*	
	Surface sown.	*Surface.*	*$\frac{1}{4}$ in. depth.*
Percentage germination ...	98	88	97
Percentage rooted	91	67	97

Conclusions.—(1) White clover seeds should never be left uncovered except during a long spell of wet weather.

(2) The best results appear to be obtained by covering the seeds to depths of $\frac{1}{4}$ in. to $\frac{1}{2}$ in.

(3) If covered to depths of over an inch only a very small percentage of seedlings may be expected to reach the surface.

Perennial Rye Grass.—As in the case of the two clovers, rye grass seeds allowed to germinate on the surface generally produced poor stands, much poorer than is indicated by the percentages of seedlings given in the Table. The germination of surface sown seeds, especially those sown in boxes and beds, was often delayed for several weeks, consequently the growth was correspondingly uneven and during the early stages many of the seedlings were weak and stunted. The inferiority of surface sowings as compared with shallow covering of the seeds is fully confirmed by the weights of green fodder obtained from the different beds; the surface beds gave only 29 per cent. of the yields produced by the $\frac{1}{8}$ in. beds.

The best results both as regards the number of surface seedlings and yields were obtained when the seeds were buried to depths varying from $\frac{1}{8}$ in. to 1 in. When the seeds were covered to depths of 2 in. about $\frac{1}{3}$, to depths of 3 in. about $\frac{6}{7}$ of the seedlings failed to reach the surface. The yields given at these depths were even poorer, only 21 oz. and 4 oz. of green fodder being obtained from the 2 in. and 3 in. beds respectively as compared with 50 oz. given by the 1 in. beds. At these depths the

surface seedlings were invariably weak and much etiolated during the early stages and were very irregular in the time taken to reach the surface; some took over five weeks to break through.

Behaviour of Seedlings from Surface Sowings.—Under suitable conditions as regards moisture the slender rootlets assisted by the long root hairs, had no difficulty in becoming fixed to the soil, but when germination was immediately followed by a spell of dry weather a large number of the seedlings failed to become established because the exposed cells of the root hairs were killed. This was clearly demonstrated by the two surface sowings in the bed experiment. The " a " bed was sown on 16th August; on the 17th and 18th it rained heavily while the next two days were warm and dull. The conditions were thus conducive to rapid germination; but on the 21st a dry spell set in, which lasted 13 days with only a short break of a few hours' rain on the 23rd. As a result only 16 per cent. of the seedlings became established. On the other hand the germination of the seeds of " b " plot, which were not sown until the 20th, was delayed until 2nd September when a long period of wet weather set in, with the result that 57 per cent. of the seedlings on this bed became fixed.

Behaviour of Seedlings when Buried too Deeply.—The rye grass seedlings are able by virtue of the pointed apices of the sheaths and first leaves to force their way up through the soil with greater ease than the clover seedlings, but when buried too deeply the food supply contained in the caryopses is exhausted before the surface is reached.

Conclusions.—(1) Rye Grass seeds should not be sown on the surface except during a long, unbroken spell of wet weather.

(2) Good results were given when the seeds were covered from $\frac{1}{8}$ in. to 1 in. In a normal year it would probably be safer, however, to cover the seeds to a depth of $\frac{1}{2}$ in. to 1 in.

(3) Only poor " take " can be expected when seeds are sown at depths of 2 in. or 3 in. and over.

Cocksfoot.—For reasons described when dealing with rye-grass, cocksfoot gave poor stands when the seeds were merely sown on the surface. The number of surface seedlings (51 per cent.) was fairly high at the time of counting, but the very low yield obtained from the surface beds—only 43 per cent. of the weight given by $\frac{1}{8}$ in. depth—suggests that the weak seedlings must have suffered very heavy winter casualties.

If a comparison of the percentage number of surface seedlings given by the different depths is made (see the Table) it will

be seen that it is not advisable to cover cocksfoot seeds even to a depth of $\frac{3}{4}$ in. The number of surface seedlings decreased with the depth, and at a depth of 1 in. the number had fallen to 50 per cent. compared with 69 per cent. given by $\frac{1}{8}$ in. depth. At 2 in. depth only 16 per cent. of the seedlings reached the surface, while the 3 in. boxes and beds were complete failures.

The superiority of the fairly shallow depths ($\frac{1}{8}$ in. to $\frac{1}{2}$ in.) over surface and deep sowings is borne out by the weights of green fodder obtained from the beds. (See the Table.)

A comparison of the results given by cocksfoot and rye grass at depths of 2 in. and 3 in. will show that cocksfoot seedlings are not able to break through such great depths of soil as rye grass seedlings, chiefly no doubt because the sheaths and first leaves are broader and the caryopses smaller than those of rye grass.

That a very deep covering has a detrimental effect on the tillering capacity of the young cocksfoot plants is shown by the following figures :—

	Surface.	*$\frac{1}{4}$ in.*	*$\frac{1}{2}$ in.*	*1 in.*	*2 in.*
Number of tillers per plant	5·2	4·6	4·6	4·5	2·6

Conclusions.—(1) As in the case of perennial rye grass, surface sowings gave very poor results.

(2) For field sowing the best depth for cocksfoot seeds appears to be about $\frac{3}{8}$ in. to $\frac{1}{2}$ in.

(3) When buried to depths of 2 in. and 3 in. cocksfoot gave even poorer results than perennial rye grass. This is an important fact since cocksfoot is often included with seeds subjected to deeper sowing, and should be started under the most favourable conditions when set in competition with quicker growing grasses like the rye grasses.

Meadow Foxtail.—*Time of Sowing.*—The uniformly low germination of the pot cultures of meadow foxtail as compared with the fairly high results given by the box cultures was probably due to the fact that the pot experiment was carried out during April when the maximum room temperature seldom exceeded 14° C. (57° Fahr.), while the box experiment was carried out in July when the maximum temperature often rose to 26° or 28° C. (79 or 82° Fahr.).

The following figures giving a comparison of the germinating capacities of meadow foxtail and perennial rye grass in spring and again in the summer are very interesting :—

	Meadow Foxtail.		*Perennial Rye Grass.*	
Depths.	*April.*	*July.*	*March.*	*June.*
$\frac{1}{8}$ in.	15 per cent.	62 per cent.	86 per cent.	80 per cent.
$\frac{1}{4}$ in.	21 „ „	48 „ „	83 „ „	78 „ „
$\frac{1}{2}$ in.	23 „ „	42 „ „	84 „ „	80 „ „

They show that while the ryegrass seeds will germinate equally well during both seasons, meadow foxtail seeds will not germinate satisfactorily except during warm weather.

That the best stands of meadow foxtail are obtained when the seeds are sown in June or July was confirmed by an experiment in which the seeds were sown weekly from early May to August.

When excessive moisture is associated with low temperature the germination is still further reduced as shown by the following figures for surface sown pots :—

	Normal watering.	*Excessive watering.*
Percentage germination	25 ...	18

It was observed that the caryopses readily decomposed when exposed to excessively moist conditions, chiefly because the seeds were kept in a constant state of saturation by the large and very hairy glumes.

Best depths.—Since the germination of the pot cultures was so low no reliance can be placed on those results.

In the box experiment the uncovered sowing gave nearly the same number of surface seedlings as ¼ in. and ⅜ in. depths, but, as in the case of perennial rye grass and cocksfoot, the germination was retarded, while many of the seedlings were dwarfed for a considerable period after germination.

All the covered sowings down to a depth of 1 in. gave fairly uniform results with the exception of ⅛ in., which actually gave 13 per cent. more surface seedlings than the ¼ in. depth. The 2 in. depth was practically a complete failure, while the 3 in. depth was a complete failure.

Conclusions.—(1) The best time to sow meadow foxtail appears to be either June or July.

(2) Satisfactory stands may be obtained from surface sowings in wet weather, but it is nearly always advisable to cover these light seeds if only to prevent them from being blown away.

(3) Although the experiments on meadow foxtail are not conclusive, it would seem that the seeds may safely be covered to depths of ½ in. and ¾ in.

(4) The sowings will result in complete failure if the seeds are covered with 2 in. to 3 in. of soil.

Rough Stalked Meadow Grass.—The results of the pot and box experiments, confirmed by observations made on the beds, show that the seeds of this species should either be left uncovered or buried very slightly, as even a shallow covering of only ¼ in. had the effect of reducing the number of surface seedlings, especially if the surface soil showed the least sign of caking over. At 1 in. depth only 4 to 6 seedlings per 100

seeds sown were able to penetrate through the soil, while at 2 in. and 3 in. depths no seedlings were able to reach the surface.

In an experiment similar to that referred to when discussing meadow foxtail, in which the seeds were sown weekly from May to August on the surface, and at a very shallow depth, the surface sowings gave the best stands when these sowings were followed by fairly long periods of wet weather; when, however, the germination was interrupted by a spell of fine weather, the best results were obtained from the lightly covered seeds. The germination of many of the surface sown seeds is often delayed for a period of 6 weeks of more, even under normal conditions as regards moisture. On the other hand, shade and excessive moisture are conducive to a good "take," as shown by the following figures given by pot cultures (surface sown):—

	Shaded.	*Exposed to light.*
Surface seedlings	61 per cent. ...	49 per cent.

That the lower percentage given by the "exposed to light" pots was due rather to the drier condition of the surface soil of these pots than to the influence of light as such is suggested by the following:—

	Excessive watering.	*Normal watering.*
Surface seedlings	63 per cent. ...	57 per cent.

Time of Sowing.—The June and July sowings produced superior stands to the May and August sowings in the weekly sowing experiment already referred to.

Conclusions.—(1) If sown under a nurse crop or during wet weather it would probably be best to leave the seeds uncovered.

(2) If sown without a nurse crop or during dry weather the seeds should be very lightly covered—preferably to about ⅛ in. to ¼ in.

In order to test the evidence given by the experiments here discussed, field trials designed largely to ascertain the depth of sowing under various operations, and to test the degree of excellence of the stands, were also conducted during 1920 and 1921. It is hoped that these results will be dealt with in a subsequent article.

CULTIVATION OF THE HOP CROP.

V.—PICKING, DRYING AND PACKING OF HOPS.

PART I.

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Picking.—Hops come into flower or "burr," as the hop-grower describes it, from the early part of July onwards, and normally seven or eight weeks elapse from this period before the hops are fit to pick, so that the beginning of hop picking coincides closely with September 1st in Kent, and about a week later in Worcester and Hereford. The formation and fertilization of the "burr" is a critical period; if the weather at this time is fine and warm, the pollen produced by the male plants drifts freely through the hop gardens and quickly fertilizes the "brush" on the "burr," but if the weather is cold and wet much of the pollen is carried to the ground by the rain, so that many hops may escape fertilization. If fertilization is delayed the hops remain in burr, looking very pretty but in a critical condition, because the soft and delicate "brush" forms a happy feeding ground for the spores of the hop mildew, which may rapidly develop upon it and cause the hops to develop into nasty little mouldy hops. Even when mould does not develop, the cones which result are small and ripening is delayed.

As soon as fertilization is complete the "brush" shrivels and the hops begin to develop. The tiny seeds begin to grow and the bracteoles in which they are contained as well as the sterile bracts and other parts of the hop commence to develop; later yellow lupulin grains begin to be formed principally near the bases of the bracteoles in close contact with the seeds.

As ripening advances the hop begins to assume a primrose yellow colour: especially is this true of the bracteoles; the bracts always retain a somewhat greenish tint. The seed, at first soft and milky, gradually develops into a nutty kernel and becomes purplish in colour when ripe. The grains of lupulin continue to develop for a considerable period after the hops have become apparently ripe, and since these lupulin grains contain the resins, etc., which the brewer wants, it is of the utmost importance to secure the maximum yield of them. Far too frequently hops are picked before they are ripe, in which case not only is the weight per acre small, but much resin is undeveloped.

The following signs may be taken as indicating when hops are fit to pick:—

They must be full-grown, and feel crisp as distinct from soft when crushed, and tend to rustle when shaken.

The colour should have changed from the vivid green of the unripe hop to a primrose yellow colour.

The kernel within the seed should be ripe and the colour of the seed purple.

The hops should contain plenty of lupulin.

Other considerations besides that of ripeness may have to be taken into account when deciding the date for the commencement of picking: of these, disease is the most important. If aphis is present, even in comparatively small quantities in the late gardens, picking must be pushed forward lest the aphis multiplies, as it is sure to do, and the hops " go black " before they can be picked. So too, if mould is prevalent, picking must not be unduly delayed lest they " go off " with red mould; on the other hand, unripe mouldy hops are unsaleable, so they should be allowed just to get ripe and then be picked as quickly as possible. Other factors to be considered are the size of the crop to be picked, the number of pickers available and the accommodation for drying at the oast; it is generally considered that the organization should allow the picking to be completed within three or at most four weeks.

Organization of Picking.—Three classes of employees are engaged in the picking. The pickers themselves with their children carry out the actual work of picking the hops, each family taking one " bin " or " basket," as the case may be; the " binmen " or " pole-pullers " are men engaged to wait upon and supervise the pickers by pulling down the hop-bines and seeing that no hops are wasted on the ground or on the bines; they are lotted out one man to from 12 to 18 baskets, and help to measure and bag up the picked hops and to load the carts; finally there is the " tallyman " or " measurer " who files the " tally " or books the number of bushels to each picker. Two methods of measuring are employed in different districts: in East Kent the measuring is done in 5 or 6 bushel baskets, in which the top of each bushel is marked by a dark line; in the Weald of Kent, Worcester and Hereford the hops are picked into bins consisting of a framework 8 or 10 ft. long over which sackcloth is stretched so that the centre bags down and forms a receptacle for the hops; the hops are emptied from these bins by a one-bushel measure, by which the quantity picked is ascertained. The advantages and disadvantages of each system probably counterbalance each other, but it is im-

portant to realise that the quantities contained in the bushel measure are very different in each case, that measured from the bin being much less than that measured in the basket, and hence prices paid for picking as well as other data based upon these units of measure, are not comparable.

Drying.—Until nearly the end of the twentieth century hop drying was practised much more as an art than a science; the hop dryer was all-powerful and carried out his work by rule of thumb; he was guided only by the experience of his former chief dryer, under whom he had worked as assistant, and generally paid scant attention to the suggestions of his employer, who probably knew little about the principles underlying the practice of hop-drying.

In the last decade of the twentieth century Sir A. D. Hall, then Principal of Wye College, began to investigate the subject; he showed how best to make use of the thermometer by placing it just below the hops so that the temperature of the air as it entered the hops could be gauged. He also published a leaflet* showing how the temperature of the air should be regulated during the period of drying so that the hops could be economically dried without being spoilt in the process. As a result of this work every grower can now exercise direct control over his hop-drying by installing a thermometer bulb just below the drying hops, connected with a scale outside the oast upon which the temperature of the drying air can be read. With such thermometers the grower can direct his dryer to follow the table of temperatures suggested by Hall, and progressive hop-growers have adopted or are adopting this or some similar method of control. There is still, however, much to be learnt about the principles of hop-drying, and the hop-growing industry is looking forward in the course of the next 10 years or so to the accumulation of much valuable knowledge by those in control of the experimental hop-drying plant recently installed under the Brewers' Institute Research Scheme on a farm belonging to Messrs. Whitbread & Co., near Paddock Wood.

The Principles of Hop-drying.—Ripe hops when picked for drying normally contain 60 to 75 per cent. of moisture, unripe hops in moist weather may contain 80 per cent. of moisture, and very ripe hops in dry weather may contain as little as 50 per cent. During the drying process the moisture content is reduced to about 5 to 8 per cent., but is allowed to rise again

* Leaflet No. 5. *South Eastern Agricultural College, Wye.* "The Temperatures of Hop Drying."

to 8 to 10 per cent. before the hops are packed. It is thus clear that the amount of water to be evaporated from the hops at the beginning of picking when hops are barely ripe may be very much greater than at the end of the season, and this, of course, coincides with experience that much greater quantities of ripe hops can be dried on the kilns than of green ones. This surplus water is evaporated by causing a current of warm air to pass through the hops whilst they lie upon a horsehair cloth supported upon the drying floor of the kiln. The next point to be considered is the means whereby the current of air or draught is produced.

Draught.—In some cases kilns are now fitted with fans to produce the necessary current of air through the hops, but in the vast majority of cases draught is produced through the operation of the well-known fact that " hot air rises."

When the air within a kiln is warmed it rises and passes out of the top through the cowl, whilst cold air enters below to take its place. The draught created is thus proportional to the difference in temperature between the air within and without the kiln, but it is also proportional to another factor, namely, the height of the kiln. Factory chimneys are built high to give better draught, so the higher the kiln the better the draught. The height both below and above the hops is important, and of the two probably that between the fires and the hair cloth below the hops is the more important, because the temperature of the air below the hops is always greater than that above and hence this air is relatively lighter and creates the greater draught. Especially in the early part of drying, the air above the hops is cooled by passing through them and therefore has no great lifting power unless it is warmed again by absorbing heat from the walls and roof above the hops. This re-absorption of heat from the walls of a warm oast is by no means unimportant and the absence of it may play a serious part with the first load of the season unless the kiln has previously been well warmed. For this reason the good dryer makes a point of lighting the kiln fires early in the morning of the first day of picking and on each Monday, for the purpose of warming his kiln, though no hops will be ready for drying till perhaps 11 a.m.

Another factor of great importance in the maintenance of a good draught is the sealing of the walls and roof so that no air can enter the kiln at any point above the position of the fire-places. Every such inlet of air weakens the effective draught.

The positions most likely to be faulty in this respect are the doors of the kiln and the roof.

One further point in this connection is worthy of notice; in some few kilns one finds the position of the fireplaces excavated, so that the firebars themselves are situated at or close to the ground-floor level and the topmost inlet of air above the fires is correspondingly lowered; this arrangement provides for additional effective height and so better draught is obtained economically, provided that facilities are made for easy carriage of coal to and cinders away from the fires.

In some kilns draught is much curtailed by the narrow apertures through which the air has either to enter or escape from the kilns, especially in still weather when there are no air currents. This restriction of openings is also liable to prejudice draught when fans are substituted for natural draught in a transformed oast.

Lastly, it is much easier to establish a good draught when the wind is blowing past the cowl, a contrivance specially fashioned to facilitate suction of air out of the kiln; in order to increase this aid to draught the kiln should be built in an open situation and trees should not be planted closely around which would tend to shelter the cowl from wind.

Evaporation.—The drying of the hop is somewhat but not completely analogous to the evaporation of water from a wet cloth, for in the case of the hop the water is contained within the tissues of the cones, partly in the bracts and bracteoles (or "petals" as the hop-grower calls them) and partly in the strig of the hop; from the former evaporation is rapid, but from the strig, protected as it is by the bracts, evaporation is much slower.

Water evaporated from the hops passes into the air, which is capable of absorbing varying quantities of water vapour according to its temperature. For each temperature of the air there is a maximum water vapour content, and if more water vapour is put into such saturated air, then either a mist is formed or water vapour is deposited as dew. Such a deposit of water vapour may occur in hop drying upon the top surface of the hops during the early part of the drying. At 50° F., a frequent temperature of the outside air during drying, air can only contain ¾ oz. of water vapour in 10 cub. yd.; at 100° F., the temperature at which hop-drying generally starts, air can contain 3½ oz. of moisture in 10 cub. yd.; whilst at 150° F., the temperature at

or slightly above which drying finishes, the maximum content of water vapour is as much as 15 oz. of water vapour in 10 cub. yd. That is to say the rate of drying of hops in a current of dry air at 150° F. may be nearly 5 times as fast as in dry air at 100° F. and nearly 20 times as fast as in dry air at 50° F.

If, therefore, hop drying merely consisted of evaporating water it is clear that the use of air at a high temperature would be both more expeditious and more economical, but another factor is involved; the passage of the air through a depth of 10 in. or so of hops spread over a wide floor is necessarily slow; contact at the beginning of drying between the cold hops and the air, as well as the evaporation of the water into it, cools the air so that as the warm air passes up through the hops its moisture content becomes greater and greater and its temperature lower and lower. If these two processes reach the point at which the air becomes saturated with water vapour, then if cooling proceeds further moisture is deposited upon the hops which are consequently "reeked" and spoilt. The initial temperature of drying must therefore be adjusted so that with the draught available the air can pass through the layer of cold hops without the deposition of any "reek." It is obvious that this initial temperature is not necessarily a constant; it may be varied somewhat with the draught available, the initial temperature of the green hops, the depth of the hops and other factors.

Temperature.—In the previous paragraphs upon evaporation emphasis has been laid upon the necessity of so controlling temperature that no condensation of reek occurs upon the upper layers of hops. Two golden rules will serve to prevent this misfortune: a warm oast before drying commences, *i.e.*, warm walls and roof, and a sufficiently low initial air temperature. The table of temperatures recommended by Hall already referred to still remains the best guide. From this extracts are quoted below:—

"*General rules if draught is moderately good.*"

"The temperature at starting should not be higher than 100° Fahrenheit."

"For the first three hours the temperature must rise steadily to about 140°."

"If the temperature falls at all during this period the colour of the hops will suffer."

"For the next five hours the temperature should be kept pretty steady; it may be allowed to rise a little more but never above 160° Fahrenheit."

"If the draught is poor the temperature must rise more slowly after starting, and four or even five hours should be taken to get to 140°."

These rules provide an admirable guide for a young dryer, who can scarcely make a mistake if he follows them intelligently.

When the hops have " feathered," a name given to describe the condition of the cones when the bracts have dried and opened out like the feathers of a bird on a frosty morning, and whilst the strigs are still sappy, the temperature is allowed to rise to 150°—155° F., to quicken the rate of drying. It is probable that such high temperature tends to evaporate some of the more volatile oils in the hops and so depreciate their flavour, but may be justified by the economy of time and fuel. In any case the temperature must not go above 160° or the hops will be burnt.

The Practice of Hop Drying.—*Loading*.—A kiln of hops can usually be dried in about 10 hours, so that each kiln can be loaded and unloaded twice in 24 hours. Hops that are picked in the morning are loaded as soon as they arrive at the oast, but the afternoon's pickings are stored until the morning's hops are dry and are loaded at night. Care must be exercised in storing the afternoon's pickings that these do not heat in the bags before they are loaded lest they be discoloured. In some cases the hops are stored in a " green-loft " above the cooling floor in the oast, so that they can be easily carried on to the kilns at night, but if so, considerable precautions must be taken in sultry weather and with unripe hops. The green loft must be well ventilated and each bag of hops should be untied and stood up, so that air can freely circulate around. A better plan, though one entailing more labour, is to erect a staging outside and near the oast upon which the bags of green hops can be laid and freely exposed to air; a temporary roof of galvanised iron is advisable to protect such hops from rain.

The quantity of hops to be loaded is a matter requiring careful judgment, and beginners may be warned that no practice prejudices profits more in hop growing than over-loading at the beginning of picking when hops are green and contain much moisture. Such practice not only results in spoilt hops from reeking but it disconcerts the drier who cannot be expected subsequently to do himself justice. When hops are fully ripe they may be loaded 10-11 in. thick on well-constructed kilns; this is equivalent to about ¾ bushel per sq. foot, East Kent measure, where hops are measured in 5 bushel baskets. In districts where " bins " are used the measured bushel of green hops is frequently much less than the basket measure. If hops are unripe, the cones small, the oast badly constructed, or the drier inexperienced, the load should be considerably less.

In loading great care must be taken to spread the hops uniformly over the drying floor and to leave them as light as

possible; light, so that the draught may be free; uniformly, so that the hops may dry evenly—or otherwise, as soon as the thin places are dry the draught of hot air passes almost completely through these spots and the denser spots dry very slowly.

Turning.—This operation is carried out after the hops have " feathered " well on top. It is done for the purpose of mixing the comparatively moist hops above with the dry hops next to the floor and also to redistribute any thick or thin places on the drying-floor. It should not be done too soon, and care must be taken not to break the hops unnecessarily, since the lower hops will have now become brittle. The operation tends to expedite drying and to produce a sample, all the hops in which are uniformly dry.

Cooling.—It is not an easy matter to test exactly at what stage drying should stop and cooling commence. On the one hand it is most important to " home-dry " the hops, since if unloaded from the kilns still moist they are either spoilt in the pockets or have to be again put on the kilns and re-dried, resulting in loss of time and much breaking of the cones. On the other hand, over-dried hops become very brittle and are broken to pieces badly in unloading and packing. The test most generally adopted is to take a handful (or several handfuls) representative of the bulk and rub them to pieces between the hands; the majority of the cones should rub down to powder, leaving only two or three cones in the handful which are still sappy, though these should be " killed " in the sense that they have already begun to shrivel. Drying should then cease, and cooling commence by damping down the fires with ashes and opening wide all blowers or shutters below the drying-floor. Cooling should occupy from one half to one hour during which time the home-dried hops absorb moisture from the air and from the few partly dry hops amongst them, thus becoming less brittle so that they can be unloaded with little damage. Per contra, the few hops still undried at the beginning of cooling complete the process.

Two commonly occurring misconceptions in regard to cooling may here be mentioned: just as in the drying process the bottom hops feel the heat first and the top hops last, so in cooling the bottom hops feel the effect of the cold air first and so does the thermometer placed below the hops: for this reason the recorded temperature rapidly falls and the hop drier is inclined to think that his hops are cool, when in fact only the lowermost hops may be so; to test whether hops are sufficiently cool the drier

must handle the hops, or alternatively leave them a length of time which experience may indicate to be correct.

Another common mistake is to open not only the shutters and doors below the hops but those above the drying floor as well; by such practice the air above the hops only is cooled, but since the cool air entering above the hops does not pass through them, the hops themselves are not cooled. This sounds very obvious, but the mistake is very frequent in the oast.

Control of Fires.—The work of the hop drier is made considerably less anxious if his kilns are fitted with large enough fireplaces; if these are greater than required he is not obliged to utilise the whole of the fire bars, but if too small they may have to burn too fiercely and constantly need attention. This fault is particularly likely to arise when hops are dried over open fires with fan draught. Wherever fires are liable to burn fiercely, or the fireplaces are nearer than usual to the drying floor a baffle plate should be suspended above them to prevent heat being directly radiated from the fires to the cloth, in which case the hops are liable to be burnt. It may be noted in passing that this radiated heat is very different in its properties from heat carried by warm air; the former "strikes" one's face when sitting before a blazing fire, the latter is produced when hot water pipes are used to warm a room. In hop drying radiated heat is dangerous and must be prevented from acting; it is the current of warm air passing through the fire by means of which the hops are dried.

At the beginning of drying and as soon as the hops have been loaded the fires are made up with large lumps of coal so that they will burn slowly and steadily for 4 or 5 hours, gradually gaining in heat as the hops begin to dry and the draught consequently improves. Should the temperature tend to rise too rapidly the fires are checked not by damping them with ashes but by raising the blowers to admit more cold air to the kiln and by this admission of air check the draught through the fire. So, too, if the fires want lifting after restoking or because they tend to deaden, this should be done by increasing the draught through the fires by partially closing blowers. Some driers use large quantities of charcoal for the purpose of raising their fires; this is costly and unnecessary except when the fire is very dead when made up.

The stoking of the fires during the latter part of drying calls for much less skill than at the outset; the only precautions necessary are to avoid great fluctuations in temperature and to

be careful that the heat produced does not exceed the given maximum.

Control of Draught.—This is closely wrapped up with the control of the fires and is fundamental to successful drying. It is especially important during still, foggy nights. Every effort must be made to get a good draught from the beginning. Assuming that the oast is sufficiently high and well ceiled, the other points of importance are to see that the cowl points directly away from whatever wind there may be; failure to do this leads to certain spoiling of the hops. Well balanced cowls, kept well oiled, should automatically swing round with the wind, but a wise precaution consists in tying a piece of string to the tongue of the cowl. The other end is attached to a stone on the ground so that, if by mischance the cowl sticks, it can easily be swung round. Next, the kiln must be warm before the hops are loaded, and the hops must be spread as lightly as possible over the drying floor.

Sulphuring.—During the drying of hops brimstone is burnt for the purpose of bleaching or mellowing the green colour of the hops, especially when unripe, so that the whole sample may present an attractive, and uniformly yellow colour. It is sometimes wrongly thought by buyers that this is the sole function of the brimstone. This is not the case for, if experimentally or accidentally hops are dried without sulphur they assume a harsh, partly green and partly bronze colour, which resembles the original colour of the green uncured hops less than does the sulphured sample. Again, such unsulphured hops have a peculiar smell resembling that of withered foliage. There is also some slight evidence that the use of the brimstone helps to hasten drying, and to preserve the hops if long storage is necessary.

The peculiar colour associated with unsulphured hops may frequently be observed by picking up a handful of hops from off the hair when the lighting of the brimstone has been delayed a few minutes after drying has commenced. This serves to indicate the importance of lighting the brimstone immediately the hops have been levelled, because the sulphur can only produce its effect on the hops before they have begun to get dry.

The quantity of brimstone required is about 1 lb. per 40 sq. ft. of drying floor, perhaps rather more when hops are green and rather less when ripe. Brimstone is sometimes burnt directly upon the fires, but a better method consists in burning it in separate iron pans within the kilns.

(*To be concluded.*)

INCREASING THE COMMERCIAL VALUE OF APPLES.

E. M. BEAR.

Now that efforts are being made to bring about improvements in our methods of packing and marketing apples, the need for better culture with a view to enhancing the commercial value of the fruit is bound to make itself felt. A grower who sets out to market his apples in accordance with standards regulating grade and quality, such as those adopted by the Federation of British Growers, quickly realises the importance of having a good sample of fruit to deal with. If the general quality of the crop as gathered from the trees is low, the proportion fit to include in the higher and more valuable grades will obviously be small, and the bulk will have to be disposed of at a much lower rate. It is, in fact, almost hopeless to attempt improved methods of packing unless an effort has been made to produce a crop of good quality.

It is to be hoped, therefore, that the movement in favour of a better system of marketing will lead to a general improvement in cultural methods. The importance of this matter is fully realised by growers in other countries who compete with us in our markets. In many cases they succeed in growing crops of apples, 75 per cent. of which are of high enough quality to pack in boxes for export under very stringent regulations as to grade and quality. On the other hand, it has been said, and probably without exaggeration, that the average crop of apples grown in commercial orchards in this country does not include more than 15 per cent. of fruit of boxable quality. There is thus plenty of room for improvement, and growers who accomplish it are not likely to go short of their reward.

The attributes of chief commercial value in apples are size, colour, and freedom from skin blemishes.

Size.—Whilst abnormal apples are not desired, it is of great importance that as large a proportion of the crop as possible should be typical specimens of their variety in this respect, since apples are graded primarily by size. It is particularly desirable in the case of cooking apples, which for most markets can hardly be too big. In a time of glut there is little demand for any but large cooking apples; and the public prefer them to small ones at any time, because they are less wasteful and less troublesome to prepare for the table. In dessert apples extra large size is not favoured, but any specimens under 2¼ in. in

diameter cannot be considered as being of the highest grade. Some of the smaller varieties commonly yield a large proportion below this size unless means are taken to improve them in this respect. On the other hand, there are a few big varieties, such as Charles Ross and Blenheim Orange, which often grow too large for dessert purposes if given generous treatment. It is desirable, therefore, that the grower should understand the conditions which influence size. In the case of most varieties, however, both cooking and dessert, his object will be to increase the average size, so as to avoid having to deal with large quantities of small fruit which must be sold at a low price.

Size in apples is influenced largely by the character of the soil. Medium loam soils or clay, which are naturally retentive of moisture and plant food, produce apples of great size and substance, and are therefore particularly suitable for cooking varieties. On soils of lighter, drier nature big, heavy apples are not so easily grown, but dessert varieties often attain better colour and more delicate and attractive appearance than on the stiffer land which gives size. But, since growers cannot materially alter the character of their soil, they need to know how size may be influenced by cultural methods.

Conditions which encourage strong growth of the trees also increase the size of the fruit. The finest apples are generally gathered from young trees that are growing vigorously. As the age of the trees increases and the wood growth decreases the apples tend to become smaller. The vigour of the trees, and consequently the size of the fruit, may be increased in several ways, the chief of which are soil cultivation, manuring, pruning and thinning the crop.

Cultivation and Manuring.—Apples grown in cultivated plantations are commonly larger than those yielded by orchards under grass. Thorough surface cultivation during the spring and summer, with the object of maintaining a dust mulch, and so hindering the rising and evaporation of moisture from the soil below, has a beneficial influence on the size of the fruit. On land inclined to be light and dry surface cultivation can hardly be overdone, particularly during the spring and early summer.

Manuring also has an important influence on size, the most useful manures for this purpose being those of a bulky organic nitrogenous character, such as farmyard or stable manure and wool shoddy. In the writer's experience a dressing of shoddy at the rate of 2 to 3 tons per acre has always given a noticeable increase in the size of apples. Whilst it is easy to overdo the manuring of young trees which are growing vigorously, and have

not come into full bearing, there is little doubt that older plantations are commonly given insufficient manure. Trees that have steadied down in growth and are in regular bearing probably require annual assistance in the way of feeding.

In some countries the requirements of fruit plantations in the way of nitrogen and organic matter are supplied by sowing a leguminous crop in autumn and ploughing it under green in the following spring. If such a crop is grown with the help of mineral fertilisers supplying phosphates and potash, the manurial needs of the trees are very cheaply and effectively provided, and increased size in the fruit is one of the benefits secured. It is very desirable that such a system should be tried in this country, and experiments made to find the best green crops for the purpose.

Grass orchards are generally manured with sheep grazing the grass closely, and at the same time receiving cake and other concentrated foods.

Pruning.—Pruning is well known to stimulate wood growth, and it increases the size of the fruit as well. There is no doubt that the finest apples are produced in orchards which receive annual attention in the way of pruning. In experiments in progress at the East Malling Research Station in Kent, trees which have the leaders tipped annually consistently yield larger fruit than trees which are allowed to grow naturally or merely thinned out where overcrowded. In the case of old trees, which have become overburdened with fruit spurs, it is very desirable to reduce the spur clusters to reasonable dimensions, and generally to thin out spurs where too numerous.

Thinning.—Undoubtedly the most direct influence on the size of the fruit is the thinning of the crop; and no other means will attain the object when too heavy a crop has set. It is a laborious and expensive process, but profitable for all that. In the case of some of the earliest cooking varieties, which are saleable when quite immature, it is perhaps allowable to leave the thinning until some of the fruit reaches a marketable size; but the thinning of most varieties should be done in May or June. The amount of thinning required depends on the quantity of fruit set. In many cases it suffices if the apples are singled, or the clusters reduced to one apple in every instance; but in some cases this leaves the fruit still too thick, and further thinning is required. As a rough rule, where large apples are wanted, they should be allowed to hang about 8 in. apart, this distance being gauged nearly enough by spanning with the hand, fingers

extended. Much thinning is avoided if the trees are regularly pruned, and the number of spurs reduced where necessary, as already described.

Colour.—Colour in apples is of great commercial value, particularly in dessert varieties. Unfortunately it is much less under the control of the grower than is size. Certain districts are noted for the high colour of the apples they produce, this being the result of natural conditions of soil and climate. The soils which yield cooking apples of great size and substance are not remarkable, as a rule, for the colour they impart to the fruit. Apples of the brightest colouring usually come from trees growing on lighter and drier land, which is therefore particularly suitable for the culture of dessert apples. On such land neither the trees nor the apples grow so big. It may be said, in fact, that conditions that make for size and growth are antagonistic to high colour. We see this when comparing apples grown in a cultivated plantation with those from a grass orchard on the same farm. The latter are always smaller but of decidedly higher colour. The same rule applies in manuring. The organic nitrogenous manures used to give size tend to reduce colouring. What it amounts to is this: colour comes with maturity, and anything that hastens maturity or ripening gives colour. Nitrogenous manures promote growth and prolong the season of development, thus delaying maturity and working against colour. If any fertilisers achieve this object they would be those supplying phosphates, which are well known to bring about early maturity. As a matter of fact, there is no reliable evidence that colour can be fed into apples, whilst there is no doubt that over-stimulation with nitrogenous manures has the opposite effect.

Colour is, of course, greatly influenced by light, especially sunshine. This is clearly seen from the extra colour of apples on the exposed parts of the tree as compared with those hidden by foliage in the centre or on the lower branches. It is really only by taking advantage of this knowledge that growers can work to secure bright colour. There should be ample space between the trees, and pruning should be done with a view to admitting light to all parts of the tree, the branches being well spaced and the centre of the head open. In the case of coloured varieties, particularly those that ripen early in the season, further help towards getting a sample of uniform colour is afforded by picking over the crop several times, taking the fruit as it colours; for apples in the shaded parts do colour eventually.

Whilst sunshine greatly assists colouring, rain also helps matters. Apples colour best when showers alternate with periods of bright sunshine. Very dry, hot seasons, with continuous sunshine, are not the most favourable to colour, although the contrary is often assumed. In the writer's district, where the drought of 1921 was very severe, and the amount of sunshine was abnormal, apples did not colour so well as they have done in normal summers.

Skin Blemishes.—A very serious amount of waste and loss in the packing of apples for market is caused by skin blemishes. Fruit that is actually damaged, either mechanically or by pests and diseases, so badly that its keeping quality is affected, is quite unfit to market at all. But even minor skin blemishes, which affect merely the appearance of the fruit, lower its value enormously. Apples packed under the label of the Federation of British Growers must not include more than 10 per cent. showing such blemishes. Growers will find that a large proportion of their crop falls short of this standard unless they give the matter very serious attention.

Blemishes arise in several ways. A few are caused by the weather, and cannot be prevented. Many mechanical injuries occur as a result of careless or improper handling during picking and can be guarded against only by training of the pickers and constant supervision of the work, together with the provision of proper appliances for carrying it out. But the majority of skin blemishes arise through the attacks of various insect pests and fungus diseases. Capsid bugs puncture and deform the fruit, aphides stunt and disfigure it, codlin moth causes "maggot-eaten" apples, and various caterpillars injure the fruit as well as the foliage. Amongst fungus diseases brown rot and apple scab are the most serious. Apples affected by the former soon decay and are entirely wasted, whilst scab, even in a mild attack, disfigures the fruit and greatly lowers the value of the crop.

The chief means of controlling these and other pests and diseases is intelligent spraying; and the grower who does not spray might as well give up all idea of improved packing and enhanced returns. It is not sufficient to wait until a particular trouble appears, and then seek a remedy. Pests and diseases are much more effectively controlled if the season's spraying campaign is carefully planned in advance, and put into operation at the right times. This is also the most economical plan, as it enables

the grower to buy his materials beforehand, when they are generally cheaper than if purchased at the last minute.

Apple Scab.—By far the most serious of the skin blemishes are those caused by the fungus disease apple scab, or black spot. This trouble is much more virulent in some seasons than in others, but it is always present to some extent, and annually causes an enormous loss to the growers of this country. Far too often the crop of varieties that are liable to scab, which include some of our best dessert kinds, contains many more than 10 per cent. of apples blemished by the disease, and in bad cases it is difficult to find an apple that is quite clean. It is therefore of the utmost importance to growers who wish to make the most of their crop by improved packing that they should be able to control scab. Unfortunately our present knowledge does not enable us to prevent it altogether, but we can control it to an extent that is quite worth while.

Mycologists seem rather to have lost faith in the value of winter spraying to prevent scab, but many growers find it distinctly valuable. In the writer's opinion spraying in early March, when the buds have just begun to move, with a simple solution of copper sulphate, 10 lb. to 100 gallons of water, is an excellent start in the year's campaign against scab, brown rot, and other fungus diseases. The chemical must be 98 per cent. pure, and should be in powder form to facilitate dissolving. Lime-sulphur at winter strength is also useful, provided that it is not applied until the outside leaves surrounding the bloom clusters are on the point of opening out. Further delay is dangerous, but slight scorching of the outside leaves apparently does no ultimate harm. If used too early lime-sulphur is of little value against scab, and in any case copper sulphate is to be preferred for the purpose. The latter scorches foliage badly, and must not be applied when the buds are at all advanced.

In some seasons this delayed winter spraying may do all that is necessary against scab, but it is never safe to rely upon it. The orthodox summer spraying is done within a fortnight after the fall of the bloom; and it ought to be repeated about a month later. Bordeaux mixture is the most effective wash to use at this time, but it is so liable to russet the fruit and to scorch the foliage of certain varieties, that it has been given up by many growers in favour of lime-sulphur used at summer strength. This is rather less effective against scab, and there is some evidence that it causes a proportion of the crop to drop before reaching maturity; but it does not russet the fruit, and is harm-

less to the foliage of all but a very few varieties if properly applied. It will be seen that we have at present no entirely satisfactory fungicide for summer use, and it is most desirable that further research should be carried out to find one.

Scab is controlled to some extent by pruning, and unless this has attention spraying is much less effective than it might be. On certain varieties, notably Cox's Orange Pippin, the winter stage of the disease may be observed in a blistered or roughened appearance of the bark of the young shoots. Such shoots should be cut off during winter pruning and burned; otherwise the fungus breaks through the bark later on and distributes spores freely. All dead wood should also be cut out. It has been found, moreover, in the pruning experiments at the East Malling Research Station, that scab is less troublesome on the fruit of trees that have their leaders tipped every winter. This benefit is not confined to varieties which show the winter stage of scab on their young shoots. It is assumed, therefore, that it is due to the fact that the tipping produces tougher, more vigorous leaves which resist the disease.

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THE LIVER ROT EPIDEMIC IN NORTH WALES, 1920-21.

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THE epidemic of Liver Rot which devastated the lowland flocks of North Wales in 1920-21 was undoubtedly the worst experienced since the noted outbreak of 1879-80, although, to judge by statements made by the older men, that attack was even more widespread. The present notes deal solely with the counties of Anglesey, Carnarvon, Denbigh and Flint. The writer had carried out work in the Aberystwyth area in connection with this disease, more particularly regarding the life history of the host snail, *Limnaea truncatula*,* which experience proved very useful in dealing with the 1920-21 outbreak.

The parasite causing the disease is the Flatworm, *Fasciola hepatica*, which inhabits the biliary duct, gall bladder and liver of sheep, cattle, rabbits, hares, etc. This worm has a complicated life history, and has as its intermediate host the small fresh-water snail, *Limnaea truncatula*, within which it

* See The Liver Rot of Sheep and Bionomics of *Limnaea truncatula* in the Aberystwyth Area. *Parasitology*, Vol. II., December, 1917, pp. 232-266.

passes its early stages; the final hosts being infected through the ingestion of infected pastures or drinking water. *L. truncatula* is abundant and widespread, especially in shallow ditches and on ill-drained pastures, and more particularly on heavy lands, but is apparently very rare, or absent, on peaty soils, and infrequent on sands (for reasons to be explained below). The outbreak apparently commenced about August, 1920, on some of the worst infected pastures, but did not become serious until about November.

The writer carried out a preliminary survey of the Agricultural Zoology of the Bangor district during the summer of 1920,* when data were obtained regarding some 800 holdings. These were almost all within a limited district, which contained relatively little of the worst affected land. It was discovered, however, that the Liver Fluke was endemic in the district examined, and caused persistent losses on a number of farms in most years: 25 such cases were recorded. In the light of subsequent experience it appears evident that a similar (or worse) state of affairs existed in most of the lowland districts of North Wales, and that on certain of the ill-drained clay soils 10 per cent. losses from this cause were not unusual; while from time to time serious (though local) losses occurred, at times involving an entire flock, or a number of neighbouring flocks. Such being the case it will be seen that the conditions favourable to an epidemic existed, which under the exceptional conditions that followed, became serious. Owing to other duties, no further field work was done in connection with Agricultural Zoology until 29th December, 1920, by which time the outbreak was widespread and the losses very severe. During the following twelve months this disease occupied a large part of the writer's attention. In all, 145 personal visits were made during the period, and a list of 260 affected farms and holdings has been made, though this is not by any means complete.

Localities affected.—The districts most severely affected were (1) the Vale of Clwyd, from Denbigh to the sea, and from Abergele to Prestatyn; (2) a narrow coastal area from Aber to near Bangor; (3) wide areas around Carnarvon; (4) about Ynys and Afonwen; (5) from Sarn Meyllteyrn to near Llanengan; (6) the vicinity of Aberdaron; (7) a wide area in south-west Anglesey extending from Llanfair P.G. to Dwyran, thence

* A Preliminary Note on the Agricultural Zoology of North Wales, *British Association*, Cardiff, 1920.

northward through Llangaffo to the Malldraeth Marsh, and up to the vicinity of Holland Arms; (8) an adjacent district extending from near Llangefni to Llangadwaladr and Bodorgan. In addition to these chief areas there were some 20 others in the four counties, mostly of smaller extent. It is interesting that in very few cases was the elevation greater than 300 ft., and the majority of the most severe losses occurred below the 100 ft. contour. Strictly speaking, the mountains escaped, the conditions there being unfavourable to a wide extension of the host snail. Owing to the custom of pasturing young sheep from the mountains to the lowlands during the period October to April, there was a concentration of sheep on the worst infected lands during that period, and many of these "tack" sheep were infected soon after arrival, so that in this way many upland farmers sustained heavy losses. For example, one sheep farmer wintered young sheep on six different lowland holdings, and four of these proved infective, causing the death of about 300. Heavy losses continued up to the end of spring, while deaths continued here and there until the late autumn of 1921. So far, up to the time of writing (January, 1922), no further fresh outbreaks have been reported, although a few chronic cases exist.

Losses due to the Outbreak.—On first taking over the work, attention was given to gaining a general idea of the extent and severity of the outbreak, and in getting the flocks away from infected pastures on to the soundest land available, and under treatment. With this end in view many farms had to be rapidly surveyed, and farmers instructed as to procedure. In some seriously infected flocks the disease was detected and the sheep marketed sufficiently early to minimise the losses. In many others the infected sheep were not sold until they had become badly affected, and in such cases realised very low prices, ewes purchased but a few weeks or months previously at from £4 10s. to £7 10s., selling at from 30s. down to 2s. 6d. each. Other flocks were allowed to die; or died with a rapidity totally unexpected by men who were accustomed to the comparatively slow wasting associated with the usual "chronic" form of the disease. Indeed, these very rapid deaths while the animals were still fat, were a marked feature of the epidemic, and led to several prevalent ideas which had to be combated. The first was that the disease was not Liver Rot at all, since death was rapid and the accustomed symptoms did not always appear. This was due to the fact that in many cases the sheep

died while the flukes, although actually present in great numbers, were frequently so small as to pass unnoticed even when the livers were examined. Again it was often contended that the disease was not endemic on the farm on which animals died, but had been imported from some other district, the sheep having been infected prior to purchase. This idea also proved to be erroneous in the majority of cases, and it was generally possible to demonstrate this to the farmers concerned by taking all the facts connected with the flock, and surveying the land. By these methods the actual place where infection had taken place could often be demonstrated. On a number of farms cattle were also affected, and in one instance over 30 died. Three flukes were obtained from the liver of a pig—the only instance reported.

As to the actual loss, it was found impossible to get even an accurate estimate, the data being incomplete, and many cases were very complicated. Very heavy individual losses were frequent, and reckoning only the price of those which died on the farm, and the difference between buying and selling price, these individual losses ranged from £50 to £1,500; £400 to £800 being frequent figures. In addition, there is the loss of the expected lamb and wool crops, etc. Many methods were recommended and tried during the year to endeavour to maintain remains of flocks free from further infection, and to prevent the infection of fresh flocks purchased during the autumn of 1921. Many farmers had to give up sheep keeping (at any rate for a time). Others, after survey of their land, were able to keep reduced flocks on their drier fields. Others fenced out or ploughed infected fields or parts of fields. Considerable drainage was undertaken, there being no doubt whatever that certain cases were aggravated by neglect of ditches, etc., especially during the war period. The majority now recognise the dangers, and that is the great step to prevention, although there is always a small residue who cannot be reached by visit, leaflet, lecture or press. It is gratifying to be able to record that taken as a whole, the agricultural community have shown interest in the scientific side of the work, and have been most helpful as regards data, experiments and in many other ways.

Causes Leading up to the Outbreak.—In a previous paper* the close connection between soil characters, meteorology, and the relative distribution and abundance of *L. truncatula*, the

* *Parasitology*, op. cit.

host snail, has been discussed: the epidemic of 1920-21 has illustrated some of these points in a most interesting manner. The snail, as already mentioned, has normally a distribution coincident with shallow ditches and pools, more particularly on clays and silts. From these centres, distribution takes place on to ill-drained adjacent land, and, in fact, anywhere where suitable conditions can be found, and it is surprising how soon such movements take place, the animals appearing to move almost automatically against any slight flow of water and so penetrating steadily during suitable weather from the centres to considerable distances in a few weeks.

Such extensions of range undoubtedly occur each winter, and indeed throughout the year should wet weather prevail. The natural check to this distribution is drought, and normally, during the average spring and summer such periods occur, killing off those snails which have reached the least suitable (most readily dried) situations; such process being progressive as long as the dry weather lasts. Although the amount of annual rainfall is of great importance here, nevertheless, its distribution throughout the months is of hardly less importance. In West Wales all winters may be regarded as wet from this biological standpoint. It is those years in which rainfall is general and persistent throughout the spring and summer that lead up to marked extensions of range of *L. truncatula*, and to its further increase by uninterrupted breeding on the ground gained. Given the infection of such snails by means of the normally present chronic or mild cases of Fluke infection usually present among the flocks, we have the conditions which precede and cause an epidemic of "Rot." The following diagram shows the rainfall in months for North Wales during the period 1920-21, illustrating the points mentioned. It will be seen that we have a period comprising the autumn and winter of 1919-20, the wet and sunless summer of 1920, and the winter of 1920-21; a period of eighteen months during which distribution and infection could proceed simultaneously. The snails became remarkably abundant, particularly on some of the low-lying heavy land, some limited areas yielding up to 130 to the square foot, as on the Malldraeth Marsh in Anglesey. In some instances several hundred acres became heavily stocked, in others only certain limited spots were invaded.

Effects of the Drought of 1921.—The long wet period described above was succeeded by the remarkable drought of 1921. This drought afforded an opportunity for studying the effects on

L. truncatula. Colonies of the snail inhabiting land of different types were watched. For instance, in Anglesey, strong and widespread colonies on limestone, sandy, and heavy marshy soils were under observation; while in the other counties colonies on various grades of soil were similarly studied. As had been previously noted* the resistance of the snail to drought is en-

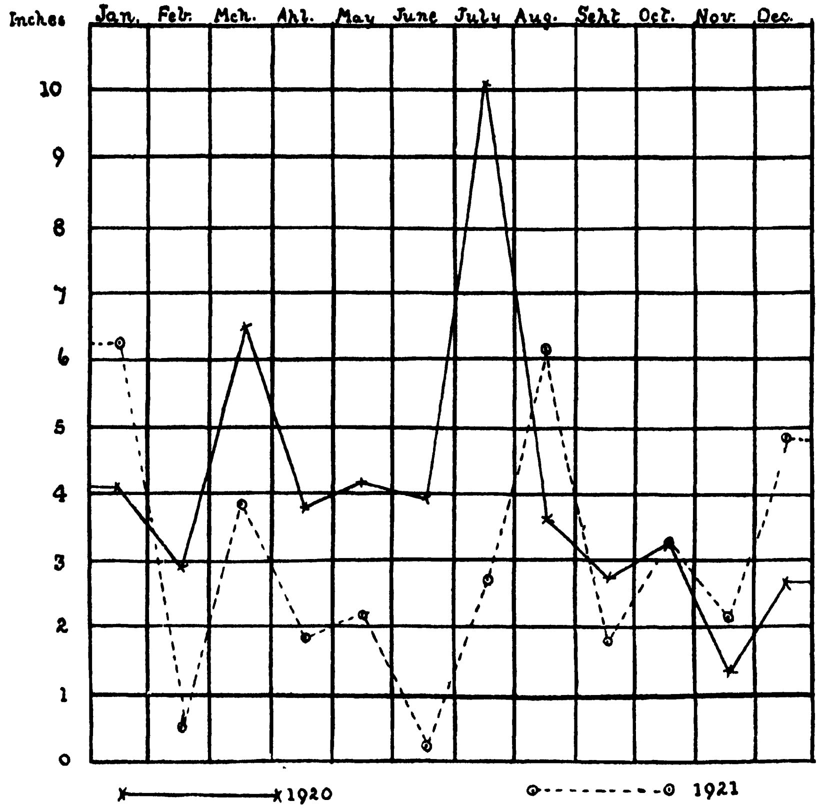

FIG. 1.—Monthly Rainfall for 1920 and 1921 at Penrhyn Gardens, Bangor.

tirely dependent upon the environment. In many instances the snails were present in numbers on grass land that was wet, but not actually under water, and such spots dried out rapidly. In such situations survival depended upon three factors (*a*) the amount and type of vegetative covering present, (*b*) soil characters, (*c*) whether the soil was level, or had cracked or been trodden ("poached") much by stock. If the land was bare and level, death speedily took place, but as the protection afforded was increased by long and dense vegetation or by shade

* *Parasitology*, op. cit., pp. 251-2 and p. 257.

of any kind, survival was prolonged. In quite a number of cases such protection enabled up to 30 per cent. of the snail population to survive right through the drought, rendering such land unfit for stock almost as soon as moisture returned.

The most favourable conditions for survival prevailed on old grass land on heavy soils which had been trodden into deep holes by horses and cattle during the winter and spring, and which dried into a series of miniature ridges, alternating with holes which were frequently from 4 to 6 in. in depth, and retained the form of the hoof, thus forming more or less overhanging and cavernlike pits. In these pits water remained for a long time, while sufficient moisture was retained in many instances to sustain life throughout the drought. A heavy growth of coarse grasses, rushes, etc., further hindered drying by affording shade from sunlight, protection from winds, and retention of dew. Shaded and grass-grown ditches, especially if on the north side of a bank, and land to the north side and under the shade of woodlands, also afforded sufficient shelter for survival in several instances. During previous work it was found that the egg masses of *L. truncatula* dried to a hard scale, but on being replaced in water, speedily resumed their original form. It was further noted that even after prolonged drought large numbers of young snails re-appeared after the return of moisture (even in ditches, etc., that had remained dry for as long as 3 months, and where all snails had died). A number of laboratory and field experiments were undertaken at the time, but owing to mischance, etc., did not produce conclusive proof of hatching of ova after drying, and since then time has not yet allowed of their repetition. Nevertheless, soon after the return of moisture numbers of minute snails appeared in many places during the autumn of 1921, so that should wet conditions again prevail during the spring and summer of 1922, there will be a further increase in the amount of land affected. It is hoped to carry out further investigations in this connection.

Field Experiments against *L. truncatula*.—Owing to lack of time, no experiments were undertaken until June, 1921, by which time the land had become very dry and vegetation dense. Nevertheless, a series of spraying trials was commenced on 1st June on heavy grass land, very rough and much "poached," situated on the Malldraeth Marsh in Anglesey. Snails were abundant and living. Plots of 1/10th and 1/20th acre were sprayed with copper sulphate in 1/1000, 1 per cent. and 2 per

cent. solutions, using Holder Pneumatic and " Mysto " Knapsack sprayers. It was found that from 100 to 120 gallons per acre was required to wet the surface, and the spraying had to be most carefully done owing to the adverse conditions. The solution 1/1000 did not give satisfactory results, and several plots failed to give conclusive evidence, since, although snails were abundant enough when sprayed, but few could be recovered a few days later. This was attributed to the activities of a number of Lapwings which frequented the plots between the time of spraying and the subsequent counting of the snails. However, one plot in another field sprayed with 1 per cent. solution yielded 112 snails, all dead, on 6th June (100 per cent. killed), while of 62 snails collected alongside the plot, on unsprayed ground, 52 were living.

In the following week several long and deep ditches near Conway heavily populated with both *L. truncatula* and *L. peregra* (an allied, but larger species) were cleared of rank vegetation, and sprayed with 1 per cent. solution of copper sulphate on 6th June. The ditches contained no water, but were still damp, and the snails living. On 14th June ditch (a) (160 yd. × 1 yd.) gave 72 per cent. dead snails, and ditch (b) (84 yd. × 1 yd.) 100 per cent. dead. Subsequently, the cost of this type of spray was worked out for 5 acres so treated in Anglesey by a farmer. A horse-drawn 40 gallon barrel sprayer was used, 100 gallons of 1 per cent. solution being applied, and the cost was 6s. per acre.

Subsequently, in October and November, a series of trials was made, using powders, which were distributed by means of hand bellows, and a Knapsack dry sprayer. This method proved very successful for narrow ditches and small wet patches, but did not give good results when tried on larger plots on the open field. The expense also was considerably higher than in the case of the copper sulphate solutions, the lowest cost working out at 16s. per acre. Nevertheless, this appears to be an excellent way of treating narrow ditches and small wet areas, being easy to carry out. The hand bellows gave the best results. The following are some of the typical results:—
(1) Copper sulphate in powder form was first tried mixed with fine slaked lime as a dilutant and spreader. Lime was soon abandoned owing to a reaction with the copper sulphate, and being too light to ensure even spreading of the heavier copper sulphate; (2) one part copper sulphate mixed with two parts flour gave even distribution and excellent results, but flour was

too expensive for use on a large scale; (3) one part copper sulphate and two parts kaolin was finally used and was successful in every way, costing 16s. per acre. By means of (2) and (3) several ditches containing thousands of snails were completely and rapidly cleared, the death rate working out at 98 per cent. to 100 per cent. Subsequent trials with two parts iron sulphate and one part kaolin failed (as did also a trial with a heavy dressing of undiluted iron sulphate, applied by an Anglesey farmer).

As matters now stand, further extensive field trials on a commercial scale are needed to test the above results. For wet land the writer would favour a 2 per cent. solution of copper sulphate, while for narrow wet ditches dusting seems advisable, as the mixture is readily made and the apparatus cheap and easy to use.

Mr. W. H. Savage, M.R.C.V.S., carried out experiments with sheep on the College Farm with both Male fern and antimony tartrate, with very considerable success.

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THE MINISTRY'S TRIALS OF VARIETIES OF POTATOES, 1921.

THE importance of the potato crop in the scheme of farming operations is demonstrated by the fact that in 1921 nearly 558,000 acres were planted in England and Wales, from which the yield was estimated to be nearly three million tons. The cost of production, for various reasons, is high, and in order that growers may be in a position to obtain the best return for their outlay the Ministry, with the co-operation of County Education Committees, has instituted a series of annual trials at numerous centres throughout the country with the object of providing information as to the most profitable varieties.

A report on the trials carried out in 1920 appeared in the issue of the *Journal* for June last, and the results of those conducted in 1921 are given in this article.

Effect of Dry Weather.—The dry summer of 1921 to some extent impaired the value of the trials. On some porous soils the ripening process was so rapid that the haulm died away prematurely leaving a very small crop of undersized tubers in the soil. In other cases where the haulm was able to obtain even a meagre supply of moisture, it remained green although very little actual growth took place either at the roots or above ground. With the advent of heavier rainfall, "second growth" and "growing out" set in. The latter occurred mainly in the South, South-Eastern and South-Western Counties and may briefly be described as the result of the first crop of undersized tubers producing tendrils from which a second crop was obtained later in the summer. This latter crop was in many cases considerably heavier than the original. In the Midlands, North and extreme West, where rain came earlier and in greater abundance, the original tubers became enlarged producing what is usually termed "second growth."

Where the crop ripened prematurely it was abnormally light, but where ripening was deferred and both crops were harvested together, almost average weights per acre were obtained. The proportion of seed to ware was, however, everywhere very high. In some crops few ware-sized tubers were found.

Another characteristic of the 1921 crop was the tendency of all varieties of oval or kidney shape to produce an abnormal percentage of round tubers.

Scheme for Trials with First Early Varieties.—The growing of very early varieties for lifting "green" is becoming an important industry in many districts, and the Early trials were accordingly designed with the object of proving whether any of the first early immune varieties possessed sufficient merit to be suitable for cultivation for this purpose. Only those counties in which an early potato-growing industry exists were asked to undertake the Early trials.

The main object of the trials was to provide information regarding the comparative marketable value of the varieties lifted in the green state, and it was not intended to demonstrate the comparative earliness of the different varieties at maturity. The varieties immune to Wart Disease chosen for experiment were Ashleaf (Broadleaf), Dargill Early, Resistant Snowdrop (or Witch Hill), and Arran Rose. These were compared with the non-immune varieties Ninetyfold and Epicure.

Supply of Seed.—In order to obtain results fairly comparable, it was decided to obtain all the seed from the same source and arrangements were accordingly made with a seed merchant in Scotland for the supply of seed potatoes of the selected varieties.

Sprouting Seed.—County Committees were asked to arrange for 28 lb. of each variety to be specially boxed and sprouted under approved methods and conditions, and for 28 lb. to be bagged and placed in the dark, in a cool store or clamp until the time of planting.

Soil and Cultivation.—It was suggested that where possible the soil selected should be a deeply-worked light to medium loam, in good condition and with an aspect having a full exposure to the sun.

Manures.—It was suggested that the soil should receive a dressing of farmyard manure in the drills at the rate of 15 tons per acre (about 2 cwt. per rod). This was to be supplemented on dates to be recorded by a dressing of artificial manures mixed in the following proportions per acre, and if possible, applied broadcast immediately before the seed was placed in the drills :—

2 cwt. sulphate of ammonia, 3 cwt. superphosphate (30 per cent. sol.), 1 cwt. steamed bone flour, and 1 cwt. sulphate of potash.

The combined mixed dressing worked out at the rate of 5 lb. per rod.

Planting.—The potatoes were to be planted on the usual dates ruling in each particular district in drills 24 in. apart, and sets 12 in. apart. The area for each variety was four rods (32 ft. by 34 ft.), which admitted of sixteen rows.

TABLE I.—*Average Rate of Yield per acre of Early Varieties on light, medium, and heavy soils in England and Wales.*

Variety.	On Light Soils.				On Medium Soils.				On Heavy Soils.			
	In England.		In Wales.		In England.		In Wales.		In England.		In Wales.	
	tons	cwt.	tons	cwt.	tons	cwt.	tons	cwt.	tons	cwt.	tons	cwt.
Arran Rose	5	2	6	6	4	0	6	4	3	2	8	14
Ashleaf (Broadleaf)	5	9	6	9	5	1	7	16	2	16	—	
Dargill Early	5	3	5	1	4	5	6	3	3	11	7	19
Snowdrop	6	4	6	9	4	1	6	2	3	8	7	6
Epicure	5	16	8	2	5	8	7	13	4	6	—	
Ninetyfold	4	0	—		4	9	—		2	19	—	

TABLE IV.—*Average Rate of Yield per acre of Second Early and Late varieties for all Centres in England and Wales.*

	Second Earlies.										Late Varieties.							
	Ally.		Arran Comrade.		Early Market.		Great Scot.		King George.		Kerr's Pink.		Lochar.		Majestic.		Tinwald Perfection.	
	tons	cwt.	tons	cwt.	tons	cwt.	tons	cwt.	tons	cwt.	tons	cwt.	tons	cwt.	tons	cwt.	tons	cwt.
Average Yield per acre in England. 228 Centres	8	7	8	11	8	12	9	19	10	2	10	7	10	3	8	15	8	0
Average Yield per acre in Wales. 95 Centres ...	10	1	10	6	11	3	12	5	11	14	14	19	13	11	11	10	10	13
Average Yield per acre in England and Wales. 323 Centres	8	15	9	0	9	1	10	10	10	10	11	9	10	19	9	6	8	12

Lifting.—Committees were asked to arrange for the potatoes to be lifted as soon as they were ready for market, and to record the results of the crop in terms of money value as well as in weight and to make careful note of the date when each variety was lifted and marketed.

Results of Trials with First Earlies.—These Early trials were carried out in ten English and six Welsh counties and the average yield of each variety from light, medium, and heavy soils is shown in Table I. It will be seen that in the English counties " Epicure " still retained its reputation as the b.st early variety for a heavy soil although it was surpassed as a cropper on light soils by " Snowdrop." The yields in the Welsh counties showed a heavier average, and this was presumably due to the heavier rainfall experienced during the growing season. " Arran Rose " gave the heaviest yield on any class of soil, viz., 8 tons 14 cwt. per acre on heavy soils in Wales, but it should be added that " Epicure " was not tested under these conditions.

When the average rates of yield at all centres are examined, it will be found that " Epicure " again heads the list as a cropper. This is entirely due, however, to the behaviour of this variety in the Welsh counties. " Snowdrop " was the heaviest cropper in the English counties and a close second in the average for all centres. It would appear therefore that the latter variety is able to withstand drought.

TABLE II.—*Average Rate of Yield per acre of each First Early variety at all the Centres.*

	Immune,								Susceptible.			
—	Arran Rose.		Ashleaf (Broadleaf)		Dargill Early.		Snowdrop.		Epicure.		Ninetyfold.	
	tons	cwt.	tons	cwt.	tons	cwt.	tons	cwt.	tons	cwt.	tons	cwt.
Average yield in England, 53 Centres	4	14	5	6	4	11	5	17	5	14	4	7
Average yield in Wales, 38 Centres	6	5	6	3	5	13	6	3	7	7	—	
Average yield in England and Wales, 91 Centres	5	4	5	12	5	0	6	0	6	4	—	

The information afforded by the trials as to the earliness of the different varieties is far from conclusive, as it appears that

most of the crops were left in the ground until they had fully matured instead of being lifted as was originally contemplated. The earliest lifting took place in East Sussex, where "Arran Rose" from sprouted seed was harvested on the 8th June and realised 21s. per cwt., as compared with 18s. per cwt. for the produce of unsprouted seed of the same variety lifted three weeks later. The difference in the period of lifting of the sprouted and unsprouted seed of the other varieties varied from 12 to 22 days in favour of the sprouted seed.

The information supplied regarding market prices was, however, interesting as showing that the date of lifting had not such a marked effect on early potatoes in 1921, as would probably be the case in normal seasons. There was a decided stiffening in prices after the very early districts of the country had been cleared and it seemed probable that there would be a serious shortage of potatoes, as second earlies were late in maturing and growers were anxious to leave them in the ground as long as possible. The effect on the prices realised by first earlies is illustrated in the returns obtained in Devonshire where crops lifted late made more money than those marketed from Kent three weeks earlier. For instance "Epicure" lifted in Devon on the 30th July made 16s. 3d. per cwt. while the same variety lifted in Kent on the 6th July made only 9s. per cwt.

Sprouted and Unsprouted Seed.—Experiments with sprouted and unsprouted sets were carried out at twelve centres. Although in two cases the unsprouted sets produced slightly better crops than the sprouted, the general weight of evidence is decidedly in favour of using sprouted sets. The average yield of the sprouted sets for the twelve centres exceeded the average yield from the unsprouted sets by 1 ton 16 cwt. per acre. Not only did the former materially increase the crop (*see* Table III), but the maturity of the crop was hastened. Thus there is a dual advantage in favour of sprouting.

TABLE III.—*Statement showing the average Rate of Yield per acre obtained with "Sprouted" and "Unsprouted" sets at 12 centres in Kent and East Sussex.*

Variety.	Sprouted. tons.	Sprouted. cwt.	Unsprouted. tons.	Unsprouted. cwt.
Kent—				
Epicure	3	9	2	17
Ninetyfold	2	6	2	1
Dargill Early	3	1	1	1
Arran Rose	2	11	3	3
Ashleaf	3	4	2	14
Snowdrop	4	1	4	3

Variety.	Sprouted. tons.	cwt.	Unsprouted. tons.	cwt.
East Sussex—				
Arran Rose	4	2	2	8
"	8	19	7	0
Ashleaf	5	4	3	3
"	10	17	8	19
Dargill Early	3	7	1	8
"	9	15	5	19
Snowdrop	4	7	2	7
"	11	1	6	18
Epicure	4	9	2	3
"	10	9	7	10
Ninetyfold	3	16	2	6
"	9	15	6	2
Average rate of yield per acre at each centre	5	16	4	0

The results obtained confirm the results of previous experiments, but there is still the greatest need to emphasise these facts and to impress them on the notice of all growers, both commercial and domestic.

Trials with Second Early and Late Varieties.—The main objects of these trials were to demonstrate :—

1. The comparative value of the immune varieties for each district.

2. Approved methods of potato culture.

The second early and main crop varieties chosen for demonstration were :—Ally, Arran Comrade, Early Market, Great Scot, King George, Kerr's Pink, Lochar, Majestic, and Tinwald Perfection.

Supply of Seed.—In order that the results obtained in the different counties should be capable of comparison it was decided to obtain all the seed used in these demonstrations from the same source. The Ministry accordingly made arrangements with a Scottish seed merchant to reserve a quantity of seed potatoes of the trial varieties, for planting on the demonstration plots.

Quantity of Seed.—Committees were asked to arrange for 28 lb. of each variety to be planted on land which had been prepared according to the instructions given below.

Manures.—The land was to receive a dressing of farmyard manure at the rate of 15-20 tons per acre, applied in the drills at the time of planting. Artificial manures were also to be applied, on dates to be recorded, in quantities somewhat as follows per acre :—Superphosphate (26 per cent. sol.) $4\frac{1}{2}$ cwt., sulphate of ammonia 1 cwt., sulphate of potash 1 cwt.

It was not expected that the above system of manuring would be adopted in every county without variation, and Committees were asked to modify the above suggestions in accordance with local customs and conditions.

Planting.—The time of planting was the usual time for this operation in each district. A distance of 30 in. between the drills, and 12 in. between the sets, was maintained throughout all the trials.

Results of Trials.—In the case of second early and late varieties 323 centres were established. The results showed that the effects of the drought were most severely felt in the Southern, Eastern and South-Eastern Counties. Conditions improved in the Midlands and West, while in the Northern Counties (York, Cumberland, Westmorland, Northumberland, and Durham) heavy crops of all the varieties were obtained.

An examination of the results obtained at all the centres shows that the average yields were not so inferior to those of 1920 as might have been expected. For varieties with which comparison is possible the yield was only one or two tons per acre lower than that of 1920.

In the English counties the heaviest crop was produced in Yorkshire by " Great Scot " where the yield was at the rate of 19 tons 9 cwt. per acre. In Wales first place was taken by " Kerr's Pink " with a yield at the rate of 21 tons 5 cwt. per acre in Flint. It will be seen from Table IV, p. 165, that the heaviest yields in every case were obtained in the Welsh counties, the average difference as compared with the English counties amounting in the case of " Kerr's Pink " to over 4 tons per acre and in the case of " Lochar " to over 3 tons per acre; in no case was the difference less than 1½ tons per acre. This difference was probably due to a more plentiful supply of moisture in the Welsh counties during the summer and autumn months.

It will be seen that " Great Scot " and " King George " maintained their reputation as the heaviest cropping second earlies. " Ally," which gave the lowest yield, appears to have been severely affected by the lack of moisture.

Amongst the late and main crop varieties " Kerr's Pink " and " Lochar," except at one centre in Hampshire, cropped most consistently in all parts of the country. " Majestic " came third amongst the late varieties at both the English and Welsh centres. The lightest cropping late variety in both England and Wales was " Tinwald Perfection."

TABLE V.—*Average Yields of Second Early and late Varieties on light, medium, and heavy soils in England and Wales.*

	Yield per acre on Light Soils.		Yield per acre on Medium Soils.		Yield per acre on Heavy Soils.	
	tons	cwt.	tons	cwt.	tons	cwt.
Kerr's Pink	11	11	11	10	11	15
Lochar	10	14	10	18	11	16
Great Scot	10	4	10	11	10	16
King George...	9	15	10	12	10	9
Majestic	9	6	9	11	9	6
Ally	8	13	8	19	9	16
Early Market	8	10	9	0	9	15
Arran Comrade	8	7	9	8	9	9
Tinwald Perfection... ...	8	6	8	2	8	18
Average yield of all varieties	9	10	9	17	10	14

If the above results are compared with those obtained in 1920, it at once becomes apparent that climatic conditions affect to some extent the relative productivity of the different soils. In 1920 the average rates of yield of all varieties were distinctly in favour of light soils; the figures being as follows:—

Average yield of all varieties on light soils:—10 tons 2 cwt. per acre.

Average yield of all varieties on medium soils:—9 tons 17 cwt. per acre.

Average yield of all varieties on heavy soils:—8 tons 10 cwt. per acre.

In 1921, however, the balance was cast in favour of medium and heavy soils, especially the latter. This is probably accounted for by the fact that the heavier soils retain natural moisture to a greater extent and for a longer period than the lighter soils. The latter would quickly dry out, save in special cases where the water table was high. Any rain which did fall would be retained longer by the heavy soils than the light; this appears to have been the case in Wales where the yields on the heavy soils were higher than in the English counties.

It is very unsafe on the results of the past season to make any definite suggestion regarding the varieties particularly suitable for heavy soils, though it would appear that "Lochar" may be regarded as coming within that category.

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A SUCCESSFUL EGG AND POULTRY CO-OPERATIVE SOCIETY.

E. G. WARREN,
Manager-Secretary.

THE Framlingham and Eastern Counties Co-operative Egg and Poultry Society, Ltd., is an offshoot of the very old-established Framlingham Farmers' Club, which has done good service in the past for agriculture.

Co-operation was first introduced to its members by Sir Horace Plunkett, supplemented later by Mr. C. C. Smith (Chairman of the Eastern Counties Farmers' Association, Ltd.), but it was left to the Agricultural Organisation Society to establish the first co-operative society in Suffolk in 1903.

The success of the Society is clearly shown by the following figures:—

	No. of Members.	*Shares.*	*Sales.*	*Collection of Eggs.*	*Share Capital.*
1903	114	1,600	£5,050	453,079	£400
1921	5,091	53,031	£282,353	24,146,059	£13,257

The Society has acquired valuable properties at some of the larger depôts, notably Ipswich, Framlingham and Wisbech, which originally cost (with improvements) £13,078, of which a proportion has been written off each year as depreciation. In accordance with the rules a reserve fund of £4,043 has been built up and the Committee receive loans at the same rate of interest as is paid on the share capital, the amount on December 31st, 1921, being £1,127. The value of a share is 5s. (fully paid up) to admit of cottagers joining, since it is recognised that, proportionately, more eggs are collected from cottage homes in the winter months than from farms, on account of the warmer housing of the hens.

The Society is registered under the Industrial and Friendly Societies Act, which affords the cheapest and simplest means of obtaining corporate existence. An individual can hold £200 worth or 800 shares, but needless to say there are many holding from one to four shares only. The Society has had no particular difficulty in obtaining share capital, interest on which is paid up to 6 per cent.

There are 50 or 60 depôts or agencies established by the Society which collect from the villages by horse or motor vehicles. These depôts are controlled by salaried or commission agents. Each agency collects, tests and despatches its own eggs in accordance with orders received from the Central Office,

Ipswich. Agents are instructed to return all bad eggs, to be replaced by good ones at the next collection. Great care is taken in appointing an agent to see that his premises are near a railway station, to prevent waste of time, petrol or horseflesh in carting eggs to the station after collecting and testing.

Each depôt has a set of books for recording in duplicate the collection and despatch of eggs, and sheets are detached and sent to the central office daily. Each agent is provided with a standing balance for the purchase of eggs, and on the purchasing daily sheet reaching the central office, the amount spent is forwarded to keep the standing balance normal.

The day book of each depôt is so ruled that the number of eggs collected and despatched on any one day can be seen at a glance, which enables the allocator of eggs at the central office to telephone, wire or write any extra order received, according to the quantity in hand.

For the first few years the Society supplied all agricultural requirements to its members, but in 1916 the Eastern Counties Farmers' Co-operative Association, Ltd., took over the Goods Department in exchange for their Egg Department, thus leaving the Society free to specialise in eggs, with the whole of the Eastern Counties as its field.

The Society had an uphill fight at first to secure reliable eggs, since producers were evidently unconcerned if an egg were fresh or not, and would not wash a dirty or stained egg, but sent as "new laid" all eggs they came across, without troubling to keep back those that had been partly incubated. The members soon found, however, that effective combination for productive or commercial purposes was not to be accomplished simply by recognition of the fact that it is necessary to combine. Certain regulations must be carried out, and it was thought advisable to adopt rules which would in time make the Society thoroughly reliable for the despatching of new laid eggs.

The Committee enforced the Rules by fining for "dirty eggs" and making a deduction for "cookers." It is interesting to give one member's analysis at first joining, and the analysis a month later.

		Eggs.	*Good.*	*Cookers.*	*Smalls.*	*Bad.*
First Collection	...	109	4	90	7	8
Later "	...	160	150	3	7	—

It is regrettable to confess that the War completely upset this system for organising a supply of reliable eggs, because, the continental supply being cut off, the multiple shops invaded

the Society's collecting areas and purchased good, bad or indifferent eggs at a slightly higher price in order to secure them, thus affecting the good work the Society had done in levelling up the quality of eggs. At the commencement of operations each member was provided with a small rubber stamp, with which to number the eggs, but it was found that clients confused them with foreign eggs, and refused them, thus defeating their own object of getting best English eggs.

The Committee worked out several examples with the idea of purchasing eggs by weight, but taking the 2-oz. standard it was found that, as a whole, the cost would be about 5 per cent. more than if bought in the ordinary local way, and there were still the " smalls " to cope with.

Each year the Society has shown a creditable trade profit, and during the last ten years has distributed in bonuses no less a sum than £19,973 4s. 3d. Members therefore have confidence in the Society, and in many instances the bonus and interest are returned for investment in further shares.

Since 1910 the Society has persevered in the preservation of eggs, and specially constructed tanks similar to those in Denmark have been built at the Ipswich depôt. Each measures 8 ft. × 7 ft. × 7 ft. 6 in., and each will accommodate 120,000 eggs. Altogether with smaller tanks at Framlingham, Stradbroke and Wisbech, about two million eggs can be preserved.

In order to prevent the selling of preserved eggs as new laid, a solution has been prepared which when applied to the shell of a preserved egg will cause it to " blush," but the solution will not affect a new laid egg. In the winter of each year, all agents are supplied with this solution, and lime or water glass eggs can easily be detected.

The Committee constantly urge members to improve their stock, by the introduction of pure bred cockerels of laying strains, either from some well-known breeder, or from members who keep reliable breeds. They also advise members to give the hens clean nests, to gather the eggs at least once daily, to keep the eggs in a cool place, and to kill or sell all male birds as early as possible save those required for stock purposes.

During 1921 an increased trade in poultry, rabbits, butter, etc., is shown, which is due to the provision of at least 300 fattening coops at Ipswich. A record handling for Xmas week alone of some 3,060 turkeys, 1,293 fowls, 329 ducks and 101 geese is noteworthy.

The Committee purchase live fowls (roasting chickens and

hens) at all times at given weekly prices per pound, weighed at Ipswich. They also purchase wild rabbits and hares during the season, and are buyers of butter, honey or other dairy produce.

One great drawback to the Society's working is the heavy charges for rail carriage, which increased 50 per cent. during 1921. To obviate this the Committee are negotiating for central premises in London where eggs can be sent in bulk by goods train, or otherwise, and by which it is estimated a considerable saving can be effected.

The eggs, poultry, and other produce are paid for at market rates and the profits realised by the Society are subsequently divided as a "bonus" to members in proportion to their deliveries.

The following application of profits for 1921 is of interest :—

	£	s.	d.
Interest on Share Capital, 6 per cent.	742	4	5
Bonus to Employees (as per Rules)	355	0	0
Bonus to Members on Eggs, Poultry, etc., sold to the Society	3,608	4	0
Reserve Fund as per Rules	429	0	0
Balance carried forward	376	0	6½
	£5,510	8	11½

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CHOCOLATE SPOT DISEASE OR STREAK DISEASE OF BROAD BEANS.

SYDNEY G. PAINE and MARGARET S. LACEY,
Department of Plant Physiology and Pathology, Imperial College, London.

THIS disease occurred as a serious epidemic in the summer of 1920. It was recognised first by an extensive marking of the leaves with chocolate-coloured spots, and was in many places confounded with "Rust" (*Uromyces fabae*). Simultaneously with the occurrence of the spots on the leaves there appeared upon the stems long and short streak-like markings of a rich bronze-brown colour, which recalled very forcibly the markings on the stems of tomato plants suffering from the "Stripe" disease. Investigation has shown that the bean disease is caused by the same organism as that producing "Stripe" in tomatoes. Now this organism was first described by Manns and Taubenhaus as the cause of "Streak" disease in sweet-peas, and was subsequently shown by them to produce streak disease of many leguminous plants. It therefore seems advisable to use the term "Streak" for this disease of beans, although perhaps "Chocolate Spot" would more adequately describe the most obvious symptom.

Occurrence of the Disease.—It is probable that field beans are never, or seldom, quite free from this disease, but it is only under exceptional weather conditions that it assumes the form of an epidemic, or does any considerable amount of damage. Such exceptional conditions prevailed in the spring and early summer of 1920. Hot, wet and thundery weather seems to have been general just previous to the appearance of the first symptoms of disease. The trouble was first reported from Hampshire in the latter part of April and South Wales in May, and rapidly spread from various centres. It was observed by the authors in Devon during June, in Sussex in July, and was reported to them successively from Buckinghamshire, Cambridgeshire and Lincolnshire. It was undoubtedly very general throughout a large part of England and Wales.

Description of the Disease.—In a typical case, beans planted in October, 1919, first showed signs of disease on 25th May, 1920, small purplish-brown spots on the leaves and streak lesions on the stems being observed on plants about five feet high. When next observed, 8th June, the plants were largely

defoliated, the remaining leaves showing a good deal of blackening. On 10th July the canes in the central portion of the field were beaten down by rain, all the leaves had fallen except a bunch at the top of each stalk, and the whole plants were being rapidly rotted by *Botrytis*, which in all cases observed followed rapidly after the " Streak " disease. In many instances the plants in the outer parts of the field were observed to be less severely attacked than those in the centre, the conditions in the outer more exposed portions being naturally drier than at the centre and hence less favourable to the spread of the disease.

Cause of the Disease.—As stated above, the organism causing this disease is the same bacillus which causes " Streak " in sweet-peas and " Stripe " in tomatoes—a small yellow bacillus named by Manns and Taubenhaus *Bacillus lathyri*. The entry of the organism into the plant may be through the stomata of the leaf; the apparent spread of the disease eastwards during 1920 would seem to suggest wind dispersal of the causative organism and entry into the leaf in this way. At the same time there is evidence that the organism is carried on the seed of winter beans, and especially on those which have been bored by the bean beetle *Bruchus rufimanus*. In its attack upon the young pod this beetle may inoculate the plant at the time of laying its eggs, and the young larvæ which develop in the pod may infect the seed when they bore their way in. Foreign *Bruchids*, e.g., *Bruchus obtectus*, can continue to breed in stored beans, and this species is not infrequently introduced on Canadian Wonder bean seed, though at present there are no records of this beetle having been found amongst field beans.

Control.—It should be remembered that the extent of the disease seems to be markedly influenced by weather conditions. The year 1920, when the disease was specially prevalent, was followed by the exceptionally dry season of 1921, in which the disease made its appearance in the early spring, but the plants soon recovered from the attack and a month later showed no sign of disease.

Where disease has occurred to a serious extent it would be well, before another crop of beans is sown, to dress the land well with potash, since it has been shown that this treatment has successfully checked the ravages of the bacillus upon tomato plants.

Further, it would be well to examine the seed carefully and to reject any showing an excessive amount of boring by beetles, and to sterilise the seed by soaking for 10 minutes in weak lysol

Portion of Broad Bean Haulm, showing Spots on the Leaves and Streak-like Markings on the Stem.

or formalin, or by dressing the seed with one of the tarry preparations supplied for the purpose.

In conclusion, the authors wish to express their thanks to Mr. W. P. Wiltshire, of the Long Ashton Experiment Station, for his reports of the disease as it occurred in South Wales, and to Mr. J. C. F. Fryer for notes upon the bean weevils.

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MARROW-STEMMED KALE FOR POULTRY.

LUCY A. HUTCHINSON, B.A. Hons. (Equivalent, Cambs.).

RECENT high prices have given a considerable impetus to intensive poultry-keeping and to "back-yard" poultry-keeping. One of the chief difficulties poultry-keepers of these classes have to face is that of providing green food for their stock. Where the so-called "yard" is of the nature of a garden, or where, in the case of larger poultry-keepers working intensively, a portion of the land can be devoted to the growing of greens, the cultivation of marrow-stemmed kale will be found to yield excellent results. The seed should be sown in late April or early May, according to the season. It may be sown in a seed bed, and the young seedlings planted out in rows 2 ft. apart and 1½ or 2 ft. apart in the row—or, as a labour-saving method, a few seeds may be dibbled into holes at the required distances, the plants afterwards being thinned out to two or three in each group. The writer's experience has been that the finest individual plants are obtained by the former method, but the greatest bulk of food by the latter. In the latter case, the thinnings supply some food from the outset. In both cases, during growth green leaves from the top of the stem can be gathered frequently, care being taken not to take sufficient to injure the growth of the plant. In this way a considerable amount of food is obtained throughout the

summer, but the real value of these greens is found when the first frosts have come, and succulent vegetables are scarcer. Any leaves left on the plants will succumb to the frost but the "marrow" contained in the stem, from the presence of which the plant obtains its name, will be protected by the outer covering which will by this time have become fibrous as in herbaceous plants. These stems should now be pulled up, and split in halves lengthwise, and thrown into the house or run. It will be found that the fowls readily eat the pith or marrow, leaving only the woody fibre of the outer coat of the stem, and in doing this they also obtain a good deal of exercise.

In order to ascertain exactly how much food was contained in the stems, some of them were weighed before being put in the runs and the woody remains afterwards gathered up and weighed. The following results were obtained:—

1. The finest individual stem was 34 in. in length, and had a circumference of 7½ in. Its weight was 2 lb. 14 oz., and the weight of the outermost coat after the fowls had eaten the "marrow" was 13 oz. Thus the amount of food from the one stem was 2 lb. 1 oz. This plant had been grown in the seed bed and transplanted.

2. Seven of the transplanted individuals, not selected, but taken in order from the plot, weighed 15 lb. 8 oz. The greatest length of a single stem was 36 in., and the greatest girth 7 in. The waste amounted to 4 lb. 3 oz., the quantity of food from the 7 stems being 11 lb. 5 oz.—an average of 1 lb. 10 oz.

3. Five consecutive groups of plants from "dibbled" seeds had the following respective weights:—6 lb. 8 oz.; 2 lb. 10 oz.; 5 lb. 1 oz.; 5 lb. 7 oz.; 5 lb. 9 oz.;—a total of 25 lb. 3 oz. The greatest length of stem was 39 in., and the greatest circumference 8 in. The amount of waste was 7 lb. 2 oz., the food extracted weighing 18 lb. 1 oz.—an average from each hole of 3 lb. 10 oz.

The results shown in (3) demonstrate clearly the superiority of the second method of sowing. The results as a whole show what a valuable green food this kale provides for poultry-keepers, especially when it is remembered that the food from the stems was available throughout a period of fairly keen frosts.

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NOTES ON FEEDING STUFFS FOR MAY.

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Ministry of Agriculture and Fisheries.

The Composition of Wheat Offals.—In a letter received recently, a correspondent stated that he experienced great difficulty in ascertaining the exact value of any wheat offals he bought, owing to the fact that the local names under which they were offered differed from those usually given in the Notes on Feeding Stuffs. It may be useful to give a brief account of our present knowledge of the composition of wheat offals, and it is hoped that this account will help readers to classify their own local products under the appropriate headings. The writer would also appreciate any information as to the local names of any wheat offals not given in the list below.

A successful attempt to classify wheat offals was made by Prof. T. B. Wood and Mr. R. H. Adie in 1916, and very useful information was obtained as a result of their investigation. The following is a brief account of the chief facts established by this investigation.

In milling wheat for flour, the process consists essentially of cracking and grinding the wheat kernels by passing them through series of steel or stone rollers and sifting out the finest particles by means of a fine silk sieve which has 130 meshes to the linear inch. The particles that pass through this sieve form the flour, and the remainder constitutes the "wheat offals." The subsequent history and separation of the constituents of the wheat offals depends to a large extent on the local milling practice and the nature of the machinery available for separation. The coarser part of the offals, known under the name of "bran" is extracted by passing the offals over a wire sieve having 16 meshes to the linear inch. The bran is that portion which fails to pass through the sieve. The greatest variation in milling practice occurs in the separation of the finer particles of offals. As with bran, the separation is a mechanical one, the offals being graded according to whether or not they pass through sieves of a given mesh. Where separation is most complete, the intermediate offals are graded into three fractions, known respectively as pollards, coarse middlings, and fine middlings. Where separation is not so complete, the separate fractions above may be combined, so that a mixture of coarse

DESCRIPTION.	Price per Qr.		Price per Ton.		Manurial Value per Ton.		Cost of Food Value per Ton.		Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv.	Price per lb. Starch Equiv.
	s.	lb.	£	s.	£	s.	£	s.		s.	d.
Wheat, British -	53/6	504	11	18	1	0	10	18	71·6	3/5	1·83
Barley, English Feeding	38/-	400	10	13	0	18	9	15	71	2/9	1·47
,, Canadian No.2 Feed	34/-	400	9	10	0	18	8	12	71	2/5	1·29
Oats, English White -	34/6	336	11	10	0	19	10	11	59·5	3/7	1·92
,, ,, Black & Grey	32/-	336	10	13	0	19	9	14	59·5	3/3	1·74
,, Canadian No.2 Feed	29/6	320	10	6	0	19	9	7	59·5	3/2	1·70
,, Argentine - -	26/3	320	9	4	0	19	8	5	59·5	2/9	1·47
Maize, ,, - -	43/6	480	10	3	0	17	9	6	81	2/4	1·25
,, South African -	38/-	480	8	17	0	17	8	0	81	2/-	1·07
Beans, English Winter -	63/3*	532	13	6*	1	15	11	11	67	3/5	1·83
,, Rangoon - -	—	—	8	0	1	15	6	5	67	1/10	0·98
Buckwheat, Manchurian	59/-	392	16	17	1	6	15	11	53·4	5/10	3·12
Millers' offals—											
Bran - - -	—	—	7	10	1	16	5	14	45	2/6	1·34
Broad Bran - -	—	—	8	15	1	16	6	19	45	3/1	1·65
Fine middlings (Imported) - -	—	—	10	0	1	7	8	13	72	2/5	1·29
Coarse middlings -	—	—	7	15	1	7	6	8	64	2/-	1·07
Pollards (Imported)	—	—	7	0	1	15	5	5	60	1/9	0·94
Barley Meal - - -	—	—	11	10	0	18	10	12	71	3/-	1·61
Maize ,, - - -	—	—	8	12*	0	17	7	15	81	1/11	1·03
,, Germ Meal - -	—	—	8	10	1	5	7	5	85·3	1/8	0·89
,, Gluten-feed -	—	—	9	10	1	11	7	19	75·6	2/1	1·12
Locust Bean Meal -	—	—	9	10	0	9	9	1	71·4	2/6	1·34
Bean Meal - - -	—	—	14	0	1	15	12	5	67	3/8	1·96
Fish ,, - - -	—	—	16	10	5	10	11	0	53	4/2	2·23
Linseed - - -	—	—	19	10	1	16	17	14	119	3/-	1·61
,, Cake, English (9°/o oil)	—	—	14	5	2	6	11	19	74	3/3	1·74
Cotton seed ,, English (5°/o oil)	—	—	8	12	2	6	6	6	42	3/-	1·61
,, ,, Egyptian (5°/o oil)	—	—	8	2	2	6	5	16	42	2/9	1·47
,, ,, decorticated (7°/o oil)	—	—	14	0*	3	11	10	9	71	2/11	1·56
Coconut Cake (6°/o oil)	—	—	9	0	1	19	7	1	73	2/-	1·07
Groundnut ,, (6°/o oil) (undecorticated)	—	—	8	15	3	5	5	10	47	2/4	1·25
Palm kernel Cake (6°/o oil)	—	—	7	10*	1	9	6	1	75	1/7	0·84
,, ,, Meal (2°/o oil)	—	—	6	10	1	9	5	1	71·3	1/5	0·76
Feeding Treacle - -	—	—	5	15	1	1	4	14	51	1/10	0·98
Brewers' grains, dried, ale	—	—	10	5	1	11	8	14	49	3/6	1·87
,, ,, ,, porter	—	—	9	5	1	11	7	14	49	3/2	1·70
,, ,, wet, ale	—	—	2	10	0	8	2	2	15	2/10	1·52
,, ,, wet, porter	—	—	2	6	0	8	1	18	15	2/6	1·34
Malt culms - - -	—	—	8	0*	2	3	5	17	43	2/9	1·47
Whole Milk (3°/o fat) -	8d. per gal.†		7	9†	0	7	7	2	15	9/6	5·09

* Prices at Liverpool. † Specially included—not market price.

FARM VALUES.	—	—	Value per Ton on Farm. £ s.	Manurial Value per Ton. £ s.	Food Value per Ton. £ s	S.E. per 100 lbs.	Value per unit S.E. s.	Market Value per lb. S.E. d.
Potatoes	—	—	2 7	0 5	2 2	18	2/4	1·25
Swedes	—	—	0 19	0 3	0 16	7	2/3	1·20
Mangolds	—	—	0 18	0 4	0 14	6	2/4	1·25
Good Meadow Hay	—	—	6 6	0 18	5 8	31	3/6	1·87
Good Oat Straw	—	—	3 9	0 10	2 19	17	3/6	1·87
Good Clover Hay	—	—	6 16	1 4	5 12	32	3/6	1·87
Vetch and Oat Silage	—	—	1 19	0 8	1 11	14	2/3	1·10

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of March and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in those notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 9s per ton. The food valne per ton is therefore £8 11s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 3d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·21d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

middlings and fine middlings constitutes the grade known as straight run middlings. A mixture of coarse middlings and pollards is similarly known as straight run pollards. The three fractions combined would constitute straight run offals. Given in the form of a diagram the results obtained are as follows :—

<table>
<tr><td rowspan="5">Wheat kernel is separated into 5 fractions.</td><td>1. Flour</td><td></td><td rowspan="5">Straight run offals.</td></tr>
<tr><td>2. Fine middlings</td><td rowspan="2">Straight run middlings</td></tr>
<tr><td>3. Coarse middlings</td></tr>
<tr><td>4. Pollards</td><td>Straight run pollards</td></tr>
<tr><td>5. Bran</td><td></td></tr>
</table>

The investigation also showed that fine middlings, coarse middlings, pollards and bran had a fairly definite chemical composition and each could be placed in its proper grade on its chemical composition. From the investigation it was also possible to group the local names into their proper grades. Thus fine middlings is identical with seconds, fine thirds and biscuit middlings.

Coarse middlings is identical with sharps, thirds, parings and boxings.

Pollards is identical with randans, coarse sharps and gurgeons.

The composition and digestibility of the four important grades of wheat offals are given in the Ministry's Miscellaneous Publication No. 32* (*Rations for Farm Stock*), and by comparing the analysis of any given sample of offals bought locally with these standard analyses it should be possible for the buyer

* Obtainable from the offices of the Ministry, 10 Whitehall Place, S.W. 1. Price 6d. post free.

to place with a fair degree of accuracy the nature of the offals sold. It is hoped eventually that millers will agree to classify their offals on a standard basis, as this will give the farmer an accurate idea of the feeding value of any wheat offal whatever its local name may be.

The Feeding Value of Whole Milk.—A correspondent has written asking that the value of milk based on a price of 8d. a gallon, and a fat content of 3 per cent., may be given in the table. It has therefore been included.

It will be seen that, at 8d. a gallon, milk is a dear feeding stuff. Its use could only be justified for feeding in special circumstances, as in the case of very young stock, or where local conditions preclude its sale. In the latter case, it would be more profitable to manufacture cheese or butter for sale and to feed the residues rather than to feed the whole milk itself.

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Effect of Coal Smoke on Plants.

COAL smoke and the presence of sulphurous acid in the atmosphere have for long been two of the greatest trials with which the Royal Botanic Gardens, Kew, have to contend, and the winter conditions are so bad that it is almost impossible to cultivate certain evergreen trees. Winds from the north and north-east almost invariably carry coal smoke to Kew. In summer the smoke may only be noticeable as a slight haze, but in winter it takes the form of dense fog. A fog of a few hours' duration causes the flowers and leaves of many indoor plants to fail, owing to the sulphurous acid in the atmosphere, whilst out of doors everything is covered with a thick deposit of fine greasy soot. This deposit is very noticeable upon water, glass, and the leaves of plants. The breathing pores of leaves become clogged and the plants are enfeebled; in fact, so disastrous is the dirt to health that it has become impossible to cultivate many of the firs and spruces.

A temporary exhibit has been arranged in Museum III at Kew, consisting of leaf specimens showing the difference between clean foliage and smoke or soot-laden foliage, and of glass from a greenhouse showing the effect of fog.

In order to increase the educational value of the Gardens, it is proposed from time to time to arrange other small exhibits at Kew, of objects of particular interest at the moment.

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Grants for Agricultural Research.

THE Ministry of Agriculture and Fisheries is prepared to receive, not later than the 15th May next, applications for grants in aid of scientific investigations bearing on agriculture to be carried out in England and Wales during the academic year commencing 1st October, 1922. The conditions on which these grants are offered are set out on the prescribed form of application (A230/1), of which copies may be obtained from the Secretary, Ministry of Agriculture and Fisheries. Whitehall Place, London, S.W.1.

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Wart Disease of Potatoes Regulations.

THE proposed new regulations for the control of Wart Disease, which were to have been brought into operation by the Ministry of Agriculture and Fisheries at the conclusion of the 1922 planting season, are still under consideration by the Minister's Advisory Committees. The Ministry can, however, inform potato growers that no restrictions additional to those operating in 1921 will be imposed which will affect the distribution of the 1922 potato crop, or of the entry into England and Wales of seed potatoes produced during 1922 in Scotland or Ireland.

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Horticulture in the Penzance Area of Cornwall.

THE Great Western Railway Company have drawn the Ministry's attention to certain statements which appeared in an article in this *Journal* for November, 1921, entitled *Horticulture in the Penzance Area of Cornwall.*

The Company point out that the present arrangements for the receiving and forwarding of the Cornish broccoli and vegetable traffic had been already the subject of discussion between the Railway Company and the Cornish Branch of the National Farmers' Union, and had been agreed to by the latter.

The whole question has recently been under discussion between the Ministry and the Railway Company, who are anxious to provide every facility for the transport of these commodities under the most favourable conditions.

The Ministry is glad to recognise the progressive and liberal attitude adopted by the Great Western Railway Company,

especially as regards their willingness to give immediate attention to any specific complaint by a grower, and to ensure the best possible transport of all perishable produce.

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How to Produce Clean Milk.

With reference to the article entitled "How to Produce Clean Milk," by James Mackintosh, O.B.E., N.D.A., which appeared in the April issue of the *Journal*, in view of recent experiments conducted at the University College, Reading, the writer wishes to make the following amendments to his article:—

Methods of Washing.—Scalding is really an attempt to sterilize, and will do much to lessen the contamination from the utensils; efficient steaming, however, will actually sterilize utensils with less labour and is therefore to be preferred. Where steam is not available utensils should be immersed in boiling water and boiled for 10 minutes; in the case of a large cooler or churns which cannot be placed in an ordinary copper, boiling water should be poured over or into them until they become unbearably hot.

Steaming.—Utensils may be enclosed in a box or tank into which steam is passed from a boiler. The steaming period will vary from 10 minutes upwards according to the supply of steam and the size of the box. If a thermometer is inserted through a small hole in the lid or side, a temperature of 210 degrees F. is sufficient evidence that the utensils are being satisfactorily treated; steaming should be prolonged to allow the contents of the box to reach this temperature. Vessels inverted over a steam jet should be kept in position until every part of the vessel becomes too hot to touch with the hand and left for at least one minute thereafter.

Strainers and Straining.—Strainers containing a layer of cotton wool which must be renewed at each milking, are the best, particularly those where the milk falls on a metal plate first instead of directly on to the straining material. The metal plate then bears the direct weight of the falling milk, and there is less chance of particles of dirt being forced through the strainer. Cloths of a fine mesh are also in common use, but the difficulty of keeping such cloths clean, and the certainty that a dirty cloth will contaminate milk indicates clearly that cotton wool strainers are much to be preferred. Where cloths are used, two should be provided—one, used in the evening,

should be soaked in cold water overnight; the other, used next morning, should be soaked as soon as the morning milking is finished. Both should be rinsed repeatedly, then washed, boiled (or steamed) and hung in a clean place till again required.

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Acarine Disease: Examination of Bees.

THE Ministry of Agriculture and Fisheries wishes to inform beekeepers that bees can now be examined for the presence of Acarine Disease, on payment of a fee of 2s. for each sample submitted. The following instructions should be carefully observed :—

(1) Specimens should be *live* bees, of not less than 30 in number, taken from off the combs and not collected from outside the hive. It is in this way only that the true condition of the colony can be diagnosed. *Dead* bees will not normally be accepted as they are unreliable for microscopic examination.

(2) The bees should be placed in a small cage or box, preferably of wood, provided with ventilation holes, and having a piece of muslin fastened across the inside for the bees to cling to during transit.

(3) A supply of candy sufficient to last for a few days, or a lump of sugar moistened with water, should be wrapped in muslin and firmly fixed to the inside of the box.

(4) The box should be secured with string and a label attached addressed to the Secretary, Ministry of Agriculture and Fisheries, 4, Whitehall Place, S.W.1, with the name and address of the sender written on the reverse side, but crossed through to prevent an error in the post.

(5) Not more than three samples may be submitted by a beekeeper at any one time, but further samples may be sent at intervals of four days. In all cases where more than one sample is sent at a time, these should be numbered 1, 2 and 3 as the case may be.

(6) At the same time as the bees are despatched, a remittance at the rate of 2s. for each sample submitted should be forwarded under separate cover. No bees will be examined unless or until this remittance has been received. Payment should be made by cheque or Postal Order, payable to the order of the Ministry of Agriculture and Fisheries and not to any individual by name, and crossed " Bank of England." Postage Stamps will not be accepted. The Ministry will not be responsible for any loss occasioned by inattention to these instructions.

(7) In the letter forwarding the remittance, as much information as possible should be given with regard to the past history and present condition of the stocks from which the bees were taken. This may help the Ministry in giving advice when furnishing a report of the examination, and will assist in general bee-disease research.

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Brompton Agricultural Discussion Society.

A NOVEL method of organising a series of agricultural lectures was adopted with success last winter by the Yorkshire Council for Agricultural Education. In the previous winter a course of twelve weekly lectures was given at Brompton, near Northallerton, which was only moderately attended. In order to stimulate interest in the proposed educational courses in the subsequent season, the prominent members of the previous class formed themselves into the Brompton Agricultural Discussion Society. They elected a Treasurer, Secretary and a committee. The subscription for membership was 1s., a printed programme was drawn up, and a lecture was arranged for each week from December to the end of March. The subjects were chosen by the members, and the County Agricultural Organiser was then asked to assist in obtaining the services of specialists in the particular subjects, the result being a well constructed programme of which the scientific side was presented by the staff of Leeds University, while practice was preached by prominent agriculturists who freely gave their services.

The lectures were followed by discussions and it was interesting to see in this small village a company of thirty to forty farmers on a miserably wet night firing questions at the lecturer as quickly as possible during the three-quarters of an hour which was open for discussion. Not least important is the fact that full reports of these lectures appeared in the local press, which devoted one or two columns per week to the society's work. The hearers therefore had an opportunity of reading the lecture again at their leisure.

Another result of this work is shown in the keenness with which those who are members of the society are taking up the question of plot and variety trials, usually at their own expense. Their results form material which is periodically brought up in the discussions following certain lectures.

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THE following communication has been received from a correspondent:—

Milking by Contract.

"The principle of paying piece-work rates for many agricultural operations is very old-standing, but its adoption in the tending of livestock is a comparatively new departure, and in certain cases is impracticable. For a considerable time it has been customary for small bonuses to be paid to stockmen, shepherds, etc., for each animal successfully reared or fattened, and in some localities milking cows have been let out on a hiring system.

Recently a large firm of dairymen, with over 400 cows on the outskirts of London, have contracted for the care and milking of their herd. Owing to the general fall in the price of agricultural products, this firm was faced with the alternative of reducing individual wages or obtaining a greater output per man. Methods were therefore sought for placing their business on a sound economic basis, and it was finally agreed between the firm and their employees that piece-work rates for milking and tending the cows should be paid. The rate agreed to is 4s. per cow per week, and each man is now milking 16 cows against 12 before the agreement. In addition each man has a cottage or 3s. per week in lieu, and milk. The day's work is done in two periods; the first commences at 4.30 a.m. and finishes at 9.30 a.m. During this period the cows are fed, milked, the sheds and mangers are cleaned and the animals are again fed. The second period commences about 12.30 p.m. The cows are milked at 4 p.m., after which the milk pails and churns are scalded ready for use the next morning, and the day is finished about 6.30 p.m. The farm steward supervises the head cowman. Milk records are taken weekly and thus careless milking is quickly detected.

It is stated that the men appear satisfied with the arrangement and no falling off in the milk supply or condition of the cows has occurred.

The dairy is run on town lines, *i.e.*, the cows are always housed, and when yielding below 6 quarts of milk per day they are sold for slaughter. Under the above conditions it is comparatively easy to adopt factory methods, but in country herds it would be much more difficult to arrange an efficient system."

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Leaflets issued by the Ministry.—Since the date of the list given on page 1051 of the February issue of the *Journal*, the following five new leaflets, of which the one marked with an asterisk will, provisionally, be supplied free, have been issued :—

No. 363.—Insecticides and Fungicides.
" 382.—Liquid Manure Tanks.
" 384.—Pig Breeding.
" 385.—Lime and Its Uses on the Land.*
" 389.—Distribution of Sittings of Eggs and Day-old Chicks for Improving the Breed of Poultry.

The following have been revised or amended :—

No. 180.—Dodder.
" 201.—The Marketing of Poultry.
" 222.—Meadow Saffron.
" 326.—Injurious Weed Seeds in Grasses and Clovers Harvested for Seed in Great Britain.
" 229.—The Breeding and Rearing of Turkeys.
" 349.—Methods of Obtaining Strong Stocks of Bees for Wintering.
" 368.—The Cultivation of Flax for Fibre.

The following Leaflets have been re-written :—

No. 128.—Advice to Beginners in Bee-Keeping.
" 157.—The Sale of Day-old Chickens.
" 176.—The Fattening of Poultry for the Table.
" 224.—Narcissus Cultivation.

The following Leaflets have been withdrawn :—

No. 289.—A Disease of Wheat.
" 171.—Rhizoctonia Diseases.

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NOTICES OF BOOKS.

Farming Costs.—(C. S. Orwin. London : Oxford University Press. Price 8s. 6d. net.) During the War the subject of farming costs received much attention, particularly in connection with the controversy surrounding the Corn Production Acts, and it still occupies a prominent position the in Agricultural Press. A revised edition of Mr. C. S. Orwin's well-known book on the subject must, therefore, be welcomed, for the author, as Director of the Institute of Agricultural Economics at Oxford, is in a position to speak with authority. The first edition (entitled "The Determination of Farming Costs") was published in 1917 and was in great demand as the only authoritative work on the subject. Since that date further experience has enabled the author to speak with even greater authority as well as to make such modifications as extended observation and criticism have shown to be desirable. Certain matters still remain, however, in regard to which Mr. Orwin, in the absence of further experience, is not prepared to give firm directions. It may be permissible to suggest that the time has come when general agreement between experts is necessary, if it were only on a conventional basis. Not the least benefit of the keeping of costing accounts is the material which they provide for comparative study, whether from year to year on the same farm, or in

relation to other farms similarly situated. For this purpose it is more important that the systems of costing pursued should be uniform than that they should be defensible in every detail on purely theoretical grounds.

One of the matters as to which further experience has led the author to modify his views, relates to the trouble and expense involved in keeping cost accounts. "There is, however," he states, "a degree of exactness required in cost determinations which may be so troublesome and so expensive of time and labour . . . . that it would not be profitable for the ordinary farmer." "But," as he properly goes on to say, "this . . . . does not affect the importance of having . . . . an exhaustive and scientific analysis of farming costs . . . . on a number of typical farms." In this connection attention may also be drawn to Appendix I, which suggests an "Alternative Basis for Cost Determination." The system outlined therein, if successful, goes far to meet the objection that costing on the approved principles described in the body of the treatise is too expensive for adoption by the "ordinary farmer." One misses, it may be said, the refreshingly pungent criticisms of other writers on the subject of costs with which the first edition closed. A.B.B.

Fruit Farming: Practical and Scientific.—(Cecil H. Hooper. London: The Lockwood Press. Price 6s. net.) The Second Edition of this book which has now been published covers a wide field by including articles on most subjects of importance to the commercial fruit grower. Many of the articles have been written by Mr. Cecil Hooper, who has had experience of fruit growing in this country and Canada, while others have been written by well-known practical growers.

The information, which is essentially of a practical nature, has been given in a condensed form readily understood by the average grower to whom this little book should appeal. H.V.T.

Agricultural Geology.—(Frederick V. Emerson, Ph.D., late Professor of Geology and Geologist for the State Experimental Station, Louisiana State University: pp. 319, 16s. 6d. net: Chapman and Hall.) This volume is suitable for University students of agriculture, but is too wide in scope and too advanced in character for those attending Farm Institutes. It should, however, find a place in the library of the latter. Obviously intended for the American student, it deals with soils and conditions which, in many cases, are unfamiliar to the British agriculturist. The portion dealing with the residual soils of various rocks, and with inherited soils, is very interesting, giving the causes of their agricultural value, and explaining many phenomena puzzling to the observer who is more agriculturist than geologist. Further, the chapter on the part played by wind in geological formations is as attractive as the account of the methods employed in binding the shifty soils most affected. Mention must be made of the discussion on "ground water," the facts in connection with which are perhaps not generally realised, while the account of alluvial terraces and the alluvial deposits of flowing water are also of interest. Glaciation and glacial soils are subjects very well illustrated; indeed, the photographs and diagrams throughout the volume arrest the eye and make particularly valuable those portions which the British student can read with advantage. A chapter on the mineral fertilisers, and their occurrence in nature, adds to the value and interest of the volume.

Insect Pests of Farm, Garden and Orchard.—(E. Dwight Sanderson. Second revised and enlarged edition by L. M. Peairs. London: Chapman Hall, 1921. Price 26s. net.) As indicated in the title, this book deals concisely with the insects east of the Rocky Mountains, except insects attacking citrus fruits. Material relating to some pests occurring also in Britain will be found in its pages, while some other American pests, familiar to us by evil repute, are absent, probably owing to the geographical range of consideration, the pests of the Pacific Coast and the irrigated country of the Far West not coming under review. The work goes further than its title, and includes insects injurious in the household, to domestic animals and to man directly, and should be distinctly useful to those whose interests lie also outside the British Isles.

The statistics as to damage, and the popular names with which many of the insects are labelled combine to strike a strong and characteristic trans-atlantic note, carrying inspiration by their vigour. The book is profusely illustrated by half tone and line blocks; these leave something to be desired, not on account of their lack of soundness, but, more particularly as regards many of the former, from poor production.

For those who desire to explore literature additional to British works on plant pests, this American book may be recommended.

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ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

Ernle, Lord.—English Farming Past and Present. (3rd Edition.) (504 pp.) London: Longmans, Green & Co., 1922, 12s. 6d. net. [63(09).]

Geological Survey Memoirs. England and Wales.—The Water Supply of Cambridgeshire, Huntingdon and Rutland. (157 pp.) London: H.M. Stationery Office, 1922, 1s. net. [628.7.]

Woodhouse, T.—The Handicraft Art of Weaving. (162 pp.) (Oxford Technical Manuals.) London: Henry Frowde, Hodder & Stoughton, 1921, 6s. net. [63.193.]

Field Crops.

Hayes, H. K. and *Garber, R. J.*—Breeding Crop Plants (328 pp.) New York and London: McGraw-Hill Book Co., Inc., 1921, 21s. [575-4.]

University of Leeds and Yorkshire Council for Agricultural Education.—No. 121:—Results of Experiments with Cereals, Swedes, Turnips and Potatoes in Yorkshire, 1921. (8 pp.) Leeds, 1922. [63.31(04); 63.332; 63.512(04).]

University College of North Wales, Department of Agriculture.—College Farm: Varieties of Oats, 1920 and 1921. (11 pp.) Bangor, 1922. [63.314(04).]

Horticulture.

Royal Horticultural Society.—Report of the International Potato Conference, Nov., 1921. (182 pp.) London: Office of the Society, 1922, 3s. [63.512(02).]

National Institute of Agricultural Botany.—Report of the Potato Synonym Committee, 1921, and Resolutions of the Potato Industry Conference. (23 pp.) Cambridge, 1922, 1s. 6d. [63.512(04); 63.512-194.]

U.S. Department of Agriculture.—Bull. 1006:—Accounting Records for Sampling Apples by Weight. (18 pp.) Washington, 1921. [63.41-198; 63.41(a).]

Fletcher, F. J.—Market Nursery Work Series. Vol. III :—Roses for Market (70 pp.). Vol. IV :—Carnations and Pinks (66 pp.). London : Benn Bros., 1922, 4s. 6d. net each. [63.52(02).]

Plant Diseases.

Ralfs, E. Marguerite.—An Abstract of the Legislation in Force in the British Empire dealing with Plant Pests and Diseases up to the Year 1920. (65 pp.) London : Imperial Bureau of Entomology, 1921, 2s. 6d. net.

Royal Society.—Reports of the Grain Pests (War) Committee. No. 9. (52 pp.) London : Harrison & Sons, Ltd., 1921, 1s. 6d. [63.27-31.]

U.S. Department of Agriculture.—Bull. 1023 :—The Relative Toxicity of Strychnine to the Rat. (19 pp.) Washington, 1922. [63.269.]

Veterinary Science.

Archer, A. H.—The Stockowner's Veterinary Aid : Containing Elementary Principles and Outlines of Treatment of Diseases and Injuries for General and Army Requirements. (136 pp.) London : Crosby Lockwood & Son, 1921, 7s. 6d. net. [619(02).]

University College of North Wales, Department of Agriculture.—Notes on the Liver Rot Epidemic of 1920-21 in North Wales. (8 pp.) Bangor, 1922. [59.169 ; 619.3.]

Dairying.

West of Scotland Agricultural College.—Bull. 98 :—Butter-making on the Farm. (62 pp. + 8 plates.) Glasgow, 1921, 2s. [63.72(02).]

Poultry.

Toovey, T. W.—Commercial Poultry Farming : A Description of the King's Langley Poultry Farm and its Modus Operandi. (2nd Edition.) (139 pp.) London : Crosby Lockwood & Son, 1922, 6s. net. [63.65(02).]

Engineering.

Society of Motor Manufacturers and Traders.—Report on the Tractor Trials held at Shrawardine, near Shrewsbury, Sept. 20th-24th, 1921. (100 pp.) London : Offices of the Society, 1921, 2s. 6d. [63.175(04).]

Gougis, A.—Manuel du Conducteur de Machines Agricoles. (350 pp.) Paris : Librairie Agricole de la Maison Rustique, 1921, 12 fr. [63.17(02).]

U.S. Department of Agriculture.—Bull. 997 :—The Cost and Utilization of Power on Farms where Tractors are Owned. (61 pp.) Washington, 1921. [63.175.]

Economics.

U.S. Department of Agriculture.—Bull. 987 :—Handbook of Foreign Agricultural Statistics. (69 pp.) Washington, 1921. [31(04).]

U.S. Department of Agriculture.—Bull. 1043 :—Crop Insurance : Risks, Losses and Principles of Protection. (27 pp.) Washington, 1922. [368.5.]

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SELECTED CONTENTS OF PERIODICALS.

Agriculture, General and Miscellaneous.

The Progress of British Agriculture, *Sir R. Henry Rew.* (Jour. Roy. Stat. Soc., Vol. 85, Part I, 1922.) [63(09); 31(42).]

Weather and Harvest Cycles, *W. H. Beveridge.* (Econ. Jour., Vol. 31, No. 124, Dec., 1921.) [551.5.]

The Evaporation of Water from Soil: Influence of Soil Type and Manurial Treatment, *B. A. Keen.* (Jour. Agric. Sci., Vol. xi., No. 4, Oct., 1921.) [63.112.]

Field Crops.

The Improvement of Poor Pasture, *W. Somerville.* (Jour. Farmers' Club, 1922, Part 2.) [63.33-16.]

The Latest Results of the Enquiry into the Spontaneous Combustion of Hay. (Int. Rev. Sci. and Prac. Agric., xii., No. 4, April, 1921.) [63.1982.]

Horticulture.

Genetic Studies in Potatoes; Sterility, *R. N. Salaman* and *J. W. Lesley.* (Jour. Agric. Sci., Vol. 12, Part I, Jan., 1922.) [575.1]

Pollination in Orchards (v. and vi.), *A. N. Rawes* and *G. F. Wilson.* (Jour. Roy. Hort. Soc., Vol. 47, Part I, Jan., 1922.) [63.41(08).]

The Winter Study of Fruit Trees, *E. A. Bunyard.* (Jour. Roy. Hort. Soc., Vol. 47, Part I, Jan., 1922.) [64.41(04).]

Live Stock.

Some Aspects of Beef Production, *T. B. Wood.* (Scottish Jour. Agric., Vol. v., No. 1, Jan., 1922.) [63.625.]

On the Relative Growth and Development of Various Breeds and Crosses of Sheep, *John Hammond.* (Jour. Agric. Sci., Vol. xi., Part 4, Oct., 1921.) [63.63(04).]

Scientific Pig Keeping with its relation to Vitamine, *M. J. Rowlands.* (Jour. Farmers' Club, Dec., 1921.) [63.64(04).]

War-Time Substitute Fodders. (Live Stock Jour., March 24th, 1922.) [63.604(a).]

Experiments with "War Forages" in Germany, Hungary, Switzerland and France. (Int. Rev. Sci. and Prac. Agric., xii., No. 4, April, 1921.) [63.604(a).]

Dairying.

Milk Recording Societies and their Effect upon the Dairy Farming Industry, *James Mackintosh.* (Jour. Farmers' Club, 1922, pp. 1-22.) [63.6(06); 63.711(b).]

Outline for a Study of the Cost of Milk Production, *J. A. Hopkins.* (Jour. Dairy Sci., Vol. 5, No. 1, Jan., 1922.) [63.714.]

The Possibility of Increasing Milk and Butter Fat Production by the Administration of Drugs, *A. C. McCandlish* and *T. M. Olson.* (Jour. Dairy Sci., Vol. 4, No. 6, Nov., 1921.) [63.711(a).]

Engineering.

The Planning and Construction of Farm Buildings, *J. B. Mendham.* (Specification, 1922, pp. 21-32.) [69(04).]

Economics.

The Cost of Tractor and Horse Labour, *C. S. Orwin.* (Scottish Jour. Agric., Vol. 5, No. 1, Jan., 1922.) [63.19; 338.58.]

Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE.
By Metchim & Son, Princes Street, Westminster, S.W.1.

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXIX. No. 3.

JUNE, 1922.

NOTES FOR THE MONTH.

Farmers' Income Tax.

In his Budget Statement made on 1st May in the House of Commons, the Chancellor of the Exchequer proposed an important alteration in the assessment of farmers' profits for Income Tax under Schedule B. Assuming that the Chancellor's proposals become law, the profits for the year 1922-23 will be reckoned as equal to the rent or annual value of the land, instead of twice the value. The position will thus revert to what it was prior to the financial year 1918-19. One effect of this will be that many farmers whose assessed income, under the assessment that has been operative for the last four years, was sufficient to make them liable to Income Tax, will be exempt this year.

Furthermore, if a farmer can prove at the end of the year that he has not made a profit equal to the annual value of his land he can claim to pay on the actual profit, or alternatively he can elect to be assessed under Schedule D, that is, on the average of his actual profits for the three previous years. In both these cases, however, the production of accounts will be necessary in order to show what the actual profits were.

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Report of the Committee on Trade Boards.

In their exhaustive review of the Trade Board system the Committee appointed by the Minister of Labour have examined at some length the fundamental reasons underlying the principle of a legal minimum rate of wages. Although the Committee consider that the State is entitled to take action to prevent the unfair oppression of individual workers, they are of opinion that it is impossible for a State-appointed body to regulate wages throughout an industry without causing a certain amount of injury both to employers and

employed. The Committee observe that unfortunately for the Trade Board system many of the increases settled by the Boards came into operation when trade was falling.

Within certain limits an increase in cost of production can be "passed on" to the consumer, but in time the point is reached where the consumer ceases to buy and decline in trade follows, accompanied by discharge of workers—a result which is much more quickly reached where the trade is subject to foreign competition. On the other hand, in many cases Trade Boards have afforded protection to the good employer, able and willing to pay a reasonable rate of wages, from unscrupulous competitors who are prepared to take unfair advantage of the economic necessities of the workers. Speaking generally the Committee are of opinion that the Boards have succeeded in abolishing the grosser forms of underpayment.

The Committee are satisfied that the establishment of the Trade Boards has had a valuable indirect advantage in improving relations between employers and workers. In trades in which no machinery for joint negotiations previously existed, the working of the Trade Board Acts, by bringing the two sides together to discuss the wages question round a table, has in many cases enabled each side to understand something of the other's point of view, and has so contributed to the growth of more satisfactory relations between the two sides and has undoubtedly had the effect of strengthening the respective organisations.

Although the Committee consider that the Trade Board system should be retained, they express the opinion that the time has come when Parliament should determine certain general principles upon which the Boards should work. In the Committee's view a clear distinction should be drawn between the use of the coercive powers of the State to insist on the payment of a subsistence wage, and the use of those powers to secure the payment of higher rates of wages for skilled workers. "It is one thing to say that an employer shall not pay an adult worker a sum insufficient for his maintenance" . . . "but any further regulation of wages should be left as far as possible to the processes of negotiation and collective bargaining." On these grounds the Committee make the somewhat revolutionary proposal that Trade Boards in future should have two quite separate functions in fixing rates of wages.

It is recommended that a Trade Board should in the first place fix a general minimum rate of wages applicable to the lowest

grade of worker in the industry. This rate of wages should approximate to the subsistence level in the place where the workers live and which the trade can bear. Rates of wages fixed on this principle should, in the Committee's opinion, continue to be enforceable with all the authority of the law. Having thus secured for all the workers in a particular trade a legal subsistence wage, the Committee consider that the fixing of special rates of wages for more skilled classes of workers in the trade should be a matter for agreement between the employers' and workers' sides of the Trade Board, who should come to their decisions in these matters without the help of the "appointed" members.

The Committee further make an important recommendation that these special rates of wages, when fixed, should not be automatically enforceable by law, but that the Trade Board should have power, if the two sides agree, to ask the Minister of Labour to confirm such rates on the principle laid down in the Corn Production Acts (Repeal) Act, which means that the confirmed rates would become an implied part of the terms of contract of all the workers concerned, and would be enforceable only by civil proceedings taken by the workers themselves (and not, as in the case of the subsistence minimum wage, by quasi criminal proceedings taken by the Government).

In examining the question of permits of exemption the Committee point out that the present Trade Board Acts do not provide for permits being issued to a "slow worker," *i.e.*, the person who, while not subject to any infirmity or physical injury, is yet incapable, owing to some constitutional defect or to age or some other cause, of earning the minimum wage fixed for the ordinary worker of his class. In the Committee's opinion the power of a Trade Board to grant permits of exemption should not be confined to cases of physical or mental infirmity, but should be widened to include incapacity from any cause. The Committee add that in view of the unavoidable delay in considering applications for permits, Trade Boards should have power in granting permits to make them operative from the date of application.

Another very interesting recommendation of the Committee is that Trade Boards should have power to fix a series of minimum rates to come into operation contingently on the occurrence of specific events. This power obviously would be very useful to a Board which had decided on the principle of basic rates of wages and which would, having once dealt with the matter, be

prepared to leave the rates to rise or fall for a period in accordance with the official cost of living index figures.

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Destruction of Rats in 1921.

WHILE steady progress was made during the period 1st April, 1921, to 31st March, 1922, with regard to the administration of the Rats and Mice (Destruction) Act, 1919, by County and Metropolitan Boroughs, Port Sanitary Authorities, and Town and District Councils to which powers have been delegated by County Councils, the year was marked by many changes in respect of the administration of the Act by County Councils. This was due to the many efforts made to achieve economy, which compelled some Counties to dispense with the services of a whole-time Rat Officer, even although those services were shown to have been of great assistance to occupiers throughout the country, and to have led to the proper observance of the Act. Moreover, the repeal of Part I of the Agriculture Act, 1920, with the subsequent termination of the appointments of Cultivation Officers, also affected the situation, as these officers had, in many cases, been appointed to carry out the work of Rat Officers in connection with their ordinary duties.

There are now 559 Local Authorities responsible for the administration of the Act, *i.e.*, 63 County Councils, 82 County Boroughs, 60 Port Sanitary Authorities, 28 Metropolitan Boroughs, the City of London and 325 Minor Authorities, of which, according to records in the possession of the Ministry, only 16 County Councils (3 of these Councils have delegated powers to all Town and District Councils), 5 Port Sanitary Authorities and 91 Minor Authorities have not yet appointed an officer responsible for the administration of the Act. In addition, most of the Local Authorities that have not appointed Rat Officers, are taking some steps to secure the observance of the provisions of the Act, although their action has not taken a very concrete form. In view of the urgent need for economy the Ministry has ceased to press for the appointment of *whole-time* Rat Officers, but is suggesting that some existing officer of the Local Authority should undertake, in connection with his ordinary duties, the task of enforcing the provisions of the Act so far as it may be possible.

A National Rat Week was held during the week 31st October to 7th November last, as a result of which at least 23 Counties,

35 County Boroughs, 5 Port Sanitary Authorities, 7 Metropolitan Boroughs and 57 Minor Authorities, took action. On the other hand no special action was taken by 85 Authorities, the reason given in 33 instances being that rat destruction was a routine matter throughout the year, and that special action was, therefore, not considered necessary or desirable. In 30 cases no reason at all was given as to why no steps had been taken to organise a Rat Week. Of the 127 Authorities which informed the Ministry that some action was taken, 44 took considerable pains to give the week great publicity, while 33 gave their own property, sewage farm, dumps, etc., special attention. On the whole, the National Rat Week may be said to have achieved its purpose in stimulating interest in rat and mouse destruction, and bringing once more before the public the fact that they are responsible for the destruction of any rats or mice infesting land or buildings in their occupation.

During the year, 734 cases of infestation were brought to the notice of the Ministry, and in respect of these infestations action was taken by the responsible Local Authority in 388 cases, and the Ministry's advice was followed with satisfactory results in 212 cases. During the year 1920, these figures were 317, 135 and 37 respectively. The increase in the number of cases received during the year 1921 over those received during the previous year, is partly due to the fact that, for the first six months, the three assistant Technical Officers of the Ministry were very active throughout the country, and brought to the notice of the Ministry infestations that would otherwise not have been reported. The termination of their engagements on the 31st December has greatly reduced the possibility of securing the proper administration of the Act, as, without definite evidence of infestation, the Ministry cannot bring pressure to bear upon backward Local Authorities.

During the year, 10½ tons of rat destructive bait were prepared at the Ministry's Factory. In addition the work in the Rat Research Laboratory greatly increased, especially in respect of the number of experiments performed, and was productive of much useful information. Several promising lines of investigation were developed. The actual number of samples received or examined was 186. In addition to chemical examinations 1,087 experiments were carried out on rats.

The analysis of these experiments would probably prove too technical to be of general interest, but it may be stated that

not only were various baits and proprietary poisons tested, but many experiments were conducted to elucidate the active agent in red squill and to obtain more certain information as to the minimum lethal dose, and the suitability of various squill poisons. Several series of experiments were also carried out to investigate the action of barium carbonate and other sorts of barium, but the results proved unexpectedly variable, and it is difficult to draw from them any satisfactory generalisation. Experiments were continued on the question of the palatability of various vehicles, especially cereals.

The number of premises treated by bait from the factory in 1921-2 was 776 (compared with 295 in 1920-1), and the number of treatments applied amounted to 1,644 (687 in 1920-1). In many cases the initial treatment resulted in the premises being completely freed from rats and mice, and 326 cases have been recorded in which treatment was very definitely successful. In the other cases the application of the bait proved successful, and further treatment was requested.

It is regretted that owing to the closing down of the Rat Bait Factory and Research Laboratory the services rendered and the research undertaken will have to cease.

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The Suppression of Weeds.

THE part played by weeds in farm economy has long been recognised by practical farmers, and the Ministry has repeatedly directed attention to the subject since the year 1900, when the leaflet on Charlock was first issued. Since that date a widely distributed leaflet (*Weeds and their Suppression*) has given condensed information on the damage done by weeds, the manner of their distribution, and the general methods which may be brought into requisition in suppressing them. Other leaflets deal specifically with certain of the more troublesome weeds.

Weeds of different species vary considerably in their life history and general vitality, and hence in the amount of damage they are able to accomplish. The measures necessary for their eradication vary accordingly. Some wild plants are of so little consequence to economic agriculture that they may be neglected; other species are harmful if plentiful; others may, if they once obtain a sure footing, prove an actual scourge, and involve very great labour, expense and loss; while yet others are injurious or even deadly poisonous to farm stock.

It cannot but be of great value to farmers and gardeners to be in a position to recognise weeds, and to have a knowledge of their life history and habits. Such a knowledge of a given weed will at the outset often enable one to judge whether it is likely to cause serious trouble, and will largely indicate what type of protective and remedial measures may most successfully be adopted.

New leaflets on Ragwort and Spurrey have recently been issued by the Ministry, and other weed leaflets have been revised. In order to place information on weeds in the hands of farmers and others in a convenient form, the whole of the leaflets so far issued have been brought together in a small volume of 86 pages.* This volume deals with seven species of thistles, three species of couch or twitch, charlock, dodder, broom-rape, coltsfoot, docks and sorrels, yellow rattle, spurrey, ragwort, meadow saffron, corn marigold, goosefoot, corn cockle, stinging nettles and poppies. It also includes general leaflets on weeds and their suppression, seed testing, and injurious weed seeds in grasses and clovers harvested for seed in Britain.

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Conciliation Committees in Agriculture.

SEVERAL agreements of the Conciliation Committees expired during the last month, but in most cases the Committees concerned have succeeded in arriving at new agreements to operate during the next few months. In Anglesey, where no agreement has existed for the last six months, the negotiations have at last resulted in a settlement, and the Committee have now arrived at an agreement to cover the half-yearly period up to 13th November.

The total number of agreements in operation on 22nd May was 45.

The agreements made since 22nd April are as follows:—

Area.	*Period.*	*Wages.*	*Hours per week.*
Beds and Hunts.	Up to 6th Oct., 1922	7½d. per hr. Guaranteed week of 50 hr.	
Cheshire - -	„ 30th Sept. „	36/-. Weekday overtime 9d. per hr. Sunday employment 10d. per hr.	54

* Collected Leaflets on Weeds, price 8d. post free, from the Ministry's Offices, 10, Whitehall Place, London, S.W.1.

Area.	*Period.*	*Wages.*	*Hours per week.*
Durham - -	Until such time that one side gives notice of alteration.	35/-. Weekday overtime 10d. per hr. Sunday employment 1/- per hr.	50
Leicester—Ashby Bosworth, Hinckley and Atherstone.	Up to 30th Sept., 1922	34/-. Weekday overtime 8d. per hr. Sunday employment 1/- per hr.	54
Somerset - -	„ 30th Sept., „	32/-. Weekday overtime 8d. per hr. Sunday employment 1/- per hr.	54
Stafford - -	„ 30th Sept., „	7½d. per hr. up to 60 hr. per week. Guaranteed week of 50 hr. Employment in excess of 60 hr. and Sunday employment 9d. per hr.	
Wiltshire -	Up to 29th Sept., 1922	30/- All overtime 8d. per hr.	52
Anglesey -	Up to 13th Nov., 1922	30/-	56
Brecon and Radnor	„ „ 1st „ „	7½d. per hr. up to 60 hr. Guaranteed week of 52 hr. Employment in excess of 60 hr. and Sunday employment time and a quarter.	„

Full particulars of the agreement for any particular area will be furnished on application to the Ministry.

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The Agricultural Index Number.

THE average of the prices in April of all descriptions of agricultural produce at markets in England and Wales was 68 per cent. above the pre-war level, as against 82 per cent. in March and 141 per cent. in April last year.

The percentage increase during each month from January, 1919, as compared with the pre-war years is shown in the following table :—

Month.	Percentage Increase. 1919. Per cent.	1920. Per cent.	1921. Per cent.	1922. Per cent.
January	148 ...	213 ...	186 ...	77
February	150 ...	205 ...	172 ...	83
March	150 ...	199 ...	158 ...	82
April	153 ...	199 ...	141 ...	68
May	132 ...	169 ...	112 ...	—
June	128 ...	164 ...	102 ...	—
July	141 ...	174 ...	100 ...	—
August	138 ...	177 ...	116 ...	—
September... ...	148 ...	181 ...	105 ...	—
October	166 ...	191 ...	90 ...	—
November... ...	182 ...	197 ...	84 ...	—
December	207 ...	194 ..	82 ...	—

The fall in April is mainly due to the decrease in the price of milk, the average price received by milk producers, after allowing for the improvement in contract prices under the recent agreement with distributors, being only about 21 per cent. above the average of the years 1911-13, as compared with 120 per cent. in March. A decline normally takes place at this period, but this year it has been considerably greater than usual.

Apart from the fall in milk prices the outstanding feature of the markets during April was the continued rise in the price of fat sheep, which rose from 60 per cent. above the pre-war value in January to 83 per cent. in February, 120 per cent. in March, and 143 per cent. in April. Fat cattle and pigs, and also poultry, advanced slightly in value during April. Wheat, barley, oats and hay were somewhat cheaper, but potatoes registered a decided advance towards the end of the month, which is shown by the monthly index number at 126 per cent. above the pre-war level. It is with potatoes that the greatest change from April to May seems likely to occur, as the April advance has since become accentuated.

Practically all descriptions of feeding stuffs were purchasable at rather easier rates during April, milling offals being about 42 per cent., maize 45 per cent., and oilcakes 62 per cent. above the average of the years 1911-13. Hardly any change was recorded in prices of fertilisers, although the strong demand for nitrate of soda resulted in an increase in price to an average of slightly over £15 10s. per ton for the month, or 46 per cent. above the pre-war price.

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Foot-and-Mouth Disease.

THE epidemic of foot-and-mouth disease in Great Britain, which started on 24th January last, appears now to have been practically mastered, as the number of outbreaks which occurred in the month from 23rd April to 21st May was only 20 out of a total of 1,099 since the beginning of the outbreak. Further sporadic outbreaks will probably occur, but it may be hoped that before long the country will be free from the disease, and all restrictions on the movement of animals withdrawn.

The total number of animals slaughtered in Great Britain in connection with foot-and-mouth disease since the first outbreak in January last is now 53,035, viz., 23,067 cattle, 20,596 sheep, 9,328 pigs, and 44 goats. These figures bear the following proportions to the total livestock population in Great Britain :—

Cattle	... ...	3.4 per thousand
Sheep	... ...	1.1 ,, ,,
Pigs	... ...	3.5 ,, ,,

The total cost of the operations against the disease amounts to approximately £755,000, of which £650,000 is the cost of compensation after deducting proceeds from the salvage of carcasses.

A more detailed statement on the subject appears on p. 285 of this issue of the *Journal*.

WISDOM AND FOLLY OF ANCIENT BOOK-FARMERS.

THE RT. HON. LORD ERNLE, P.C., M.V.O.

THE story of Joseph and his brethren has often been re-enacted in the protracted struggle between science and practice in agriculture. The elder sons of Jacob were plain practical men, experienced in the traditional routine of stock-rearing and corn-growing, wearing the weather-stained garments of their industry. It is possible that their younger brother, with his dainty clothes and indoor airs, had spoken disrespectfully of their lives and methods. He was a theorist. The day came when they saw their chance. "Behold this dreamer cometh!" So they stripped him of his variegated raiment and thrust him into a pit: but Joseph lived to save them from starvation and become their leader.

Yet it must be admitted that farmers have had good reason to distrust the pseudo-scientific advice of book-farmers. Before the end of the 18th century it was often indistinguishable from quackery, often false in its conclusions, often so mixed with folly as to be ridiculous, often based on hasty generalisations, often so extravagant in its promises as to arouse suspicion. The practical man opposed to the theories of would-be teachers his traditional routine of farm management. Its growth had been slow. It had been built up by protracted processes. Here and there some isolated agriculturist had, either by accident or experiment, chanced upon some new process or substance which increased the yield of his crops. Often the discovery would be ignored or forgotten, perhaps to be revived a century later. Sometimes it would be tried and confirmed by neighbours, spread over an ever-extending circle, and gradually incorporated in the general stock-in-trade of farmers. Tested experience of this kind is not easily disturbed. Why the given results follow may be unknown; it is enough that they are produced. Another process will not be adopted merely because it is new. Proof of better results is needed, and printed pages, especially when reading was a rare accomplishment, carry less weight than ocular demonstration. Seeing is believing. Sound sense often lies behind the conservatism of farmers. Mistakes in agriculture are costly, and sure returns are necessary where subsistence is at stake. The path of the

industry is strewn with the wreckage of those who have tried to grow rich by short cuts.

When true science began to speak, it had to remove a mass of suspicion engendered by the quacks who professed to speak in her name. Agricultural chemistry dates from the discovery of the composition of air at the close of the eighteenth century. Before that time the prejudices entertained by agriculturists against the unverified theories of book-farmers were often justified. They rested on a sure instinct. But rural ruts were so deep that they restricted the horizon. Old agricultural writers often recommended practices, now in universal use, a century before they were adopted. Their newfangled notions might have enriched the great-grandfather instead of the great-grandson. It may be interesting to collect a few illustrations. At least they emphasise the importance of keeping the eyes open. They show that some of the methods which from 1780 to 1870 made British agriculture famous, were anticipated and discussed in theory more than a century and a half before they were adopted in practice.

16th Century Literature.—The history of agricultural literature printed in English begins with the 16th century. In 1520 a Dutch bookseller, named John Dorne, carried on his business at Oxford. His trade was especially brisk at the two great annual fairs in May and October. In his day-book for that year he enters his sales. He sold one copy of "Husbandry" at one penny, and 3 copies of "Medecens voer Hors" at two pence each. Both books have disappeared. They have been thumbed out of existence.

The true father of the English literature of the farm is John Fitzherbert. He was a Derbyshire man, whose *Boke of Husbondrye* was printed in 1523. He did not presume to write on farming till he had accumulated a practical experience of 40 years. In this restraint he set a good example, which has not always been followed. A shrewd hard-headed man, he wrote a sensible book. Even in those days Derbyshire was famous as a horse-breeding county. Fitzherbert owned "60 mares or more." He knew the trade. He had as little faith in a horse-dealer or a "horse-leche" as in a "potycarye." "It were harde," he says, "to truste the best of them." His object in writing seems mainly to have been to demonstrate the superiority of a farm in separate occupation to a farm cultivated on the prevalent system of a tenancy in common. The few improvements which he suggests, and the arguments

by which they are enforced, strike us as antiquated. Both are now everywhere accepted: but it takes a heavy hammer and many blows to drive a nail through hearts of oak. It was two centuries and a half before they were recognised in practice. He insists on the advantages of a farm in individual occupation, divided by hedges and ditches into separate enclosures. In the first instance, he admits, the expenditure would be considerable, but it would pay any farmer with a twenty years' lease to make the outlay. He would get his money back with interest by saving the charges to common herdsmen' and shepherds and the expenses of hurdles and stakes, by enjoying the longer season on the grass which the enclosed land allowed, and by gaining a greater choice of the time for marketing his calves and lambs. Enclosed land was better for the stock and better for the corn.

Fitzherbert did not believe in the abandonment of tillage or the adoption of ranching. He advocates mixed husbandry. If a farmer is to prosper, stock and corn must go together. A man, he says, cannot thrive by corn unless he has live-stock, and he who tries to keep stock without corn must either be "a buyer, a borrower, or a beggar." Though his resources were limited, though winter-keep remained an unsolved problem, and roots and artificial grasses were still unknown, he sees with a prophetic eye the verification of the maxim that "a full bullock-yard and a full fold make a full stack yard." If his advice had been heeded in the years 1480-1640, England might have escaped some of the misery which was caused by the transformation of common arable farms into sheep-walks, and by the consequent loss of employment, rural depopulation and destruction of houses and farm buildings.

Half a century later than Fitzherbert came Thomas Tusser, whose *Hundred Points of Husbandry* (1557), afterwards expanded into *Five Hundred Points of Good Husbandry* (1573), was written in doggerel verse. The book was so popular and so frequently republished that his name cannot be omitted. It is a valuable storehouse of information on existing practices, habits and customs. Tusser was a recorder rather than an improver. He makes no new suggestions, and has no theories to expound. With him begins the long line of agricultural writers, who failed in the business before they turned to literature, and thus strengthened the prejudice against book-farming. He was "a musician, schoolmaster, serving man, husbandman, grazier, poet—more skilful in all than thriving in his

vocation." He "spread his bread with all sorts of butter but none would ever stick thereon," and he is said to have died in the debtors' prison of the Poultry Counter. Probably his best remembered lines are:—

"At Christmas play and make good cheer
"For Christmas comes but once a year."

On one question, which from time to time is still disputed, both these old authors had made up their minds. Neither had any doubt that rooks were greater malefactors than benefactors. They charge them with preferring grain to grubs. Against pigeons, rooks and crows Fitzherbert proclaims a crusade. Tusser proposes to arm mothers with slings, and boys with bows and arrows, to drive away the marauders. Tudor England knew nothing of Board Schools.

Green Manuring.—One of the few suggestions made in these early books is that of green-manuring. Buck-wheat or "Brank" is suggested for the purpose In Tudor times the expedient had a special value. It smothered the weeds, restored the humus, improved the texture of the soil, and provided manure when dung was scarce. Its use was the greater because the "seeds" crop, which serves similar purposes more effectively, was still unknown, but the danger of drying up the water supply limits its application to the more rainy districts. Buck-wheat is a quick grower and a good weed smotherer. It is for these reasons also recommended by Child (1651). It was sown in May and ploughed in in July. But Mortimer (1712) considered it a better practice to feed it to dairy cattle when it was coming into blossom. If allowed to seed and ripen, the grain was largely used for pigs and poultry. Milled for human food, it made a very white flour, which, in Stewart times, was highly esteemed for pancakes.

Child mentions other crops for green manure. Tares were, he says, so employed in Kent. He also recommends lupins, probably from his knowledge of Latin writers. The Romans were fully aware of their value before a corn crop, though the scientific reason for the richness of their fertilising qualities was a discovery of the last century. In this connexion may be mentioned another form of catch-cropping. William Ellis of Gaddesden, whose writings wefe famous in the first half of the 18th century, attributes the success of Hertfordshire farmers, among other causes, to growing tares on turnip fallows

to be grazed in May. Neither mustard nor vetches seem to have been used for catch-crops.

The Introduction of Clover, Grasses and Turnips.—Fitzherbert and Tusser knew no other country than England. Barnaby Googe was both a traveller and a translator. His *Foure Bookes of Husbandry* (1577) are translated from the Latin work of Conrad Heresbach published at Cologne, and a few pages are added of Googe's own observations on agricultural practices. The farming of the Low Countries, with which the book deals, was the most advanced in Europe. But, then as well as subsequently, English farmers looked on foreign innovations with suspicion. They had their full share of the national insularity. In this case they lost an opportunity. Googe gives the first hint of the new resources which, 200 years later, so marvellously enriched English farmers. He recommended not only the use of rape, but that of what he calls "Trefoil or Burgundian grass." "There can be," he says, "no better fodder devised for cattle." He also suggests, as supplying valuable food for live stock, the field cultivation of turnips. In the Low Countries they were extensively cultivated in the fields. In England, they were only just beginning to struggle into gardens as vegetables for human use to be "boyled and eaten with flesshe."

Whether Googe succeeded in converting any English farmers to the value of roots and grasses is unknown. As he gives a list of men whose farming was an object-lesson to their less advanced neighbours, it is possible that some may have tried the suggestion. If there were any converts, they were few. A dry year may have discouraged the experiment of roots. It may have stiffened the resistance of farmers to their introduction, and confirmed their stereotyped answer that the new crops would not grow in England because their ancestors had never grown them. It was not till more than 160 years later that the new resources began, on any general scale, to struggle into use in this country.

In clover and turnips new sources of wealth were thus offered to farmers as early as 1577. The want of winter-keep, for instance, accounted for the half-starved condition of English live stock, which only survived the winter as skin and bone. Here was a partial solution of the problem, and a means of carrying a larger and a heavier head of cattle and sheep. The new crops were destined to be the pivots of mixed farming.

Throughout the 17th century writers kept pegging away at turnips and temporary grasses. Little attention was paid. In the existing system of open-field farming there was no room for either crop. All the partners in the village farm enjoyed grazing rights over the fallows as well as over the other arable fields from corn-harvest to seed-time. Any enterprising man therefore who wished to grow turnips would grow them for the benefit of his neighbours. Up to 1773, it was impossible, without the assent of all the partners, to alter the rotation by which all were bound, or to interpolate either of the new crops. They were, therefore, out of the reach of open-field farmers. But occupiers of enclosed farms were almost equally backward.

Once again, seventy years after Barnaby Googe, attention was called to the methods of foreigners by an eyewitness. In a clear and concise treatise, Sir Richard Weston described (1645) the field cultivation of artificial grasses and turnips in Brabant and Flanders. At first the book circulated in manuscript, but it was printed in 1649-50 and again in 1651. Arthur Young, with characteristic enthusiasm, calls Weston "a greater benefactor than Newton," because he offered bread and meat to millions. But the times were unfavourable to progress. Traditionally, Oliver Cromwell interested himself in the introduction of the field cultivation of turnips. He is said to have paid a farmer named Howe £100 a year for being the first man to grow them successfully in Hertfordshire. Their cause, however, was not helped by the mountebank extravagance of writers like Adolphus Speed (1659), who commends them to farmers as the only food for cattle, sheep, swine and poultry, sovereign for conditioning "Hunting dogs," admirable as an ingredient in bread, supplying "exceeding good Oyl" and "excellent Syder," and yielding "two very good crops each year."

Other writers, on more moderate lines, urged the addition of temporary grasses and turnips to the resources of farmers. Andrew Yarranton, by his personal example and influence, succeeded, between the years 1653 and 1677, in establishing clover in Worcestershire and the adjoining counties. He was one of the most interesting men of the time. Starting as a linendraper's apprentice, he found the "Shop too narrow and short" for his mind. He took leave of his master, lived a country life for some years, served as a soldier in the Civil Wars, turned consulting engineer in 1652, and studied various means of bettering the condition of the country. Impressed

with the exhaustion of the " rye-lands " by " long tillage," he suggested clover as the remedy. His *Improvement by Clover* (1665) was " so fitted to the countrey-man's capacity that he fell on Pell-mell " and the new crop " doubled the value of the Land." Elsewhere, it was long before clover emerged " from the fields of gentlemen " into common use. Jethro Tull, writing in the reign of George II, says that, if advised to sow clover, " farmers would certainly reply ' Gentlemen might sow it if they pleased, but they (the farmers) must take care to pay their rents.' " In 1768 it was still unknown in many counties.

Equally strenuous was the opposition to turnips. It must, however, be remembered that at first they were sown broadcast. The name of the first man, Michael Houghton, who grew them at Hawsted in Suffolk in 1700, is preserved. " I introduced turnips into the field," wrote Jethro Tull of Berkshire, " in King William's reign; but the practice did not travel beyond the hedges of my estate till after the Peace of Utrecht " (1713). In 1716 they were still a source of wonder to the neighbours when they were grown in Scotland by the Earl of Rothes. On the other hand, they made their way more rapidly in Norfolk and Essex where they were established before 1684. Daniel Defoe, who began his tour of Great Britain in 1722, says that Norfolk was the county " where the Feeding and Fattening of Cattle, both Sheep as well as black Cattle, with Turnips, was first practis'd." Hertfordshire may perhaps dispute the claim. Defoe's *Tour* was published in 1738, the year in which died Lord Townshend, whose zealous advocacy of the use of turnips as the pivot of Norfolk farming, gained him the nickname of " Turnip " Townshend.

The Corn Drill.—None of the three Tudor agricultural writers who have been so far mentioned, were men of any scientific pretensions, even in the restricted sense in which the words can be used of our Elizabethan ancestors. Fitzherbert wrote his practical experiences. Tusser recorded facts. Googe reported foreign practices. Sir Hugh Plat was, in the alertness of his mental attitude, more akin to the scientific leaders of the 19th century. A man of an ingenious and inventive turn, he farmed near St. Albans. Among his suggested improvements was that of drilling, or, as it was then called, " setting " corn (1600). His attention was drawn to the advantages of the practice by accident. " A silly wench "

dropped wheat seeds into the holes meant for carrots. He claimed that, by dibbing wheat instead of sowing it broadcast, a man could increase his yield per acre from 4 quarters to 15. Few farmers were likely to believe so extravagant a promise. But Plat was on the track of a great discovery, although he and his immediate successors took the dibbing of beans as their model, and intended the seed to be deposited by hand. Others worked in the same direction. Francis Maxey (1601) described the new manner of setting corn, and invented a machine which punched holes in the ground.

On similar lines Gabriel Plattes championed the new process so eagerly that he gained the nickname of the "Corn-setter." He rivalled Sir Hugh in the extravagance of his promises. Those who followed his system and used his drill (patented 1639) were promised a hundred-fold increase in their yield. He died shirtless, and starving for want of bread, in the streets of London. But agricultural writers did not lose sight of the suggestion. Worlidge, for example, whose *Systema Agriculturæ* (1669) deserved, on the whole, in spite of many defects, its reputation as a standard authority, came nearer the mark. He invented a drill to make the furrow, sow the seed, and deposit the manure. The machine is figured and described in his book. But he appears never to have made or tested his implement. Professor Bradley of Cambridge, who (1727) constructed the machine from Worlidge's drawing, found that the instrument would not perform any of its three functions.

It remained for Jethro Tull, the greatest original genius in the history of English farming, to invent and perfect a practical drill. It was used for the first time on his farm at Crowmarsh, near Wallingford in Berkshire, somewhere between the years 1699 and 1709. On the drilling of corn and roots he based much of his system of clean farming. By drilling wheat and keeping the soil clean and stirred between the rows, he grew it for many years in succession without manure. Applied to turnips the process trebled their value. But, as he mournfully says, though he grew better crops, at less cost, and with greater economy of seed than his neighbours, none followed his example. It was not till drilling of corn and roots had been enthusiastically adopted in Scotland, and thence had drifted back over the English borders into the northern counties, that it gained any general hold in this country, years after Tull's death.

A Variety of Manures.—The most interesting of Sir Hugh Plat's observations are those on manures for arable and pasture land. They are contained in the second part of his *Jewell House of Art and Nature* (1594). He is so enamoured of his subject that manure presents itself to his vision as a Goddess with a Cornucopia in her hand. Basing his theories on Bernard Palissy, he argues that perpetual cropping robs the earth of her vegetative salt. Therefore the wise husbandman must continuously replace the elements of its fertility. He recommends a valuable list of manurial substances. He urges that existing practices allowed the vegetative salts of dung to evaporate by long exposure to the sun and so waste the richest properties of farmyard manures. He therefore suggests its accumulation in covered pits. He advises the use of marl, with a warning that it should be proportioned to the needs of different sorts of soil. His other manurial substances include lime, street refuse, the subsoil of ponds and "watrie bottomes," the brine of Cheshire "salt pittes," ashes, the hair of beasts, malt-dust, soap-ashes, putrified pilchards, entrails of animals or fish, and blood offal.

Fifty years later than Plat, several agricultural writers were busy on the subject of manures. Among them was a man of ingenious and inquiring mind, Gabriel Plattes, the "Cornsetter." His "*Discovery of Infinite Treasure*" was the use of the fertilising qualities of the substances carried off by water. In the soil of streams, in mud of tidal waters, and in all "coloured" water, he finds the "fatness" of the land. He suggests catch-pits to receive the water of "land-flouds," especially where they come from fertile fields or paved market-towns. He also advises ditches and sluices to admit tides to run in swiftly and pass out slowly. In both cases, the deposit makes a valuable manure which will fertilise the most barren soil. All "coloured" water should be similarly utilised on the land insteady of being allowed to run to waste.

Contemporary with Plattes, were Walter Blith (1649) and Child (1651). Both give lists of manurial substances which supplement the suggestions of Plat. Putting their recommendations together, we get a fairly complete list of the fertilisers recommended for use by agricultural writers of the 17th century. They include marl, lime, and chalk; farm-yard manure, which Child says must not be too much exposed to sun and rain; pigeon and poultry dung; swine's dung, which Fitzherbert says was harmful because it bred thistles; ashes,

both of wood and " sea-cole "; soot; malt-dust; " raggs of all sorts "; " coarse wooll, nippings and tarry pitch-markes " (Blith); horn, or shavings of horn; seaweed " of all sorts, rotted " (Child); salt dross, " much used on " meadows near Nantwich (Child); marrow-bones (Blith); blood and urine (Child); fish and fish-bones.

Child mentions the New England practice of using on the land a fresh-water fish, called the " Ale-wife, because of its great belly," very full of bones. It was, he says, caught in weirs, and sold in large quantities to farmers. Both writers suggest mud from rivers, and Child adds " owse " from marshy ditches and foreshores. Both especially recommend a soil full of small shells, taken out of the beds of certain rivers. Child, who calls it " snaggreet," says that it was much used in Surrey. Blith, who calls it " snaylecod," says that one load was worth three of horse or cow dung, that it was found in the Thames Valley and near Uxbridge, and that men gained a " gallant living " by bringing it to the surface and selling it on the river bank at from one and twopence to two and fourpence a load.

Child also recommends, as has been already noted, the practice of green manuring, and the use of lupins for the purpose. Child's *Large Letter* on agricultural improvements is full of useful suggestions. But, in the same breath, he suggests that our live-stock and the agricultural wealth of the country should be increased by the introduction of " Black Foxes, Muske-cats, Sables, Martines," and, above all, the elephant as a useful beast of draught and burden, " 15 men usually riding on his backe together." His advice has not been wholly neglected. In the Cheviots to-day there is a flourishing skunk farm.

Jethro Tull, it may be noted, objected to dung as a weed-carrier. In the writings of William Ellis we find the manures actually in use on a Hertfordshire farm in 1733-50, by an advanced farmer. Chalk was largely employed, pits being sunk to obtain the substance. Among the new ingredients are rabbit's dung and rape-dust. London refuse was freely bought; quantities of " cony-clippings, horn-shavings, rags, hoofs-hair, ashes, etc.," were bought from " Mr. Atkins of Clerkenwel." To the manures in use in the county were added, fifty years later, boiled or burned bones, sheep-trotters and malt-dust.

Before the advent of agricultural chemistry, and the establishment of the principles of plant nutrition, the science of manuring was neither studied nor understood in theory. Probably no farmer in the 16th or 17th century could have explained the precise action of the different substances which he applied. But observation of results by individuals had built up an imposing list of suggested manures, some of which had taken their place in the traditional routine of the best farmers. It is interesting to note that, though the theory was unknown, practical experiment had provided the essential elements of fertility—nitrogen, phosphoric acid and potash. All the native resources, except the coprolite deposits, were in fact utilised. It is the method of using these native materials, in their portable form, and in the discovery and use of new or imported ingredients, such as guano, phosphatic rock, the Stassfurt deposits of potash, or basic slag, that the increased command of fertilising substances mainly consists.

The effect of cattle droppings is so obvious that dung must have been employed as a fertiliser in the infancy of agriculture in every country. Its treatment might be and may be improved. But it was sheer improvidence, or stark necessity which urged farmers to waste their one natural and all-round manure by mixing it with straw, kneading it into lumps, drying it, and burning it as fuel. Standish (1611) notices the practice. It was evidently wide-spread, for Lawrence (1727) speaks of it as prevailing in Yorkshire and Lincolnshire, and considered it important enough to suggest that all leases should contain a restrictive covenant "Cowdung not to be burnt for fuel." Arthur Young (1770) found the practice in Buckinghamshire and Northamptonshire. "There cannot," he says, "be such an application of manure anywhere but among the Hottentots."

To the Romans the value of marl, lime and chalk were known, not as direct plant food, but as indirect fertilising agencies. There is some evidence that the original home of their use was Britain. But, with the invasion of the Saxons, many practices were temporarily forgotten. The use of these substances may have lingered on in farming tradition; it may have been revived by ecclesiastical agriculturists from the writings of Pliny, Varro, Columella, or Palladius; it may have been discovered afresh from their effect on the land when thrown up in digging ditches or foundations. Marl was certainly used in the 13th century in England. But the practice seems to have fallen into disuse.

Fitzherbert, who notices its cost,—it is, he says "exceeding chargeable,"—regrets that it was becoming obsolete, and Gervase Markham, writing at the close of the 16th century, infers from the age of the timber growing in marl pits that they had been abandoned for 260 or 300 years.

Barnaby Googe recommends the use of chalk in moderation; but he adds the popular saying that "grounde enriched with chalke makes a riche father and a beggarly sonne." Its use on the heavy lands of Hertfordshire has been already noticed. "Mixing earths," such as chalk on heavy clay and "red clay" on sandy soils, is one of the practices to which Ellis attributes the agricultural success of the county. Large quantities of chalk were also imported into Essex from Kent, whence it was brought up the estuaries and distributed to the farms. Gypsum was another of the substances used, especially in Kent and Sussex. Towards the end of the eighteenth century, its value was more extensively recognised. When Cornish or Devonshire farmers brought sea sand from the coast on their pack-saddles, they probably did not know the exeat nature of its value, or that it mainly lies in the carbonate of lime contained in the broken shells of which it largely consists. But they anticipated the modern market gardeners of Penzance in the use of the substance; they had experienced, in some way or other, the utility of its agency.

Other substances more directly contribute to plant food. That the value of soot was soon discovered is natural enough. Thrown on some waste place, its useful properties would be observed. Whether its effect in raising the temperature of the soil, or lightening its texture, or deterring slugs and snails, or its direct fertilising qualities, commended its use to the first observer, is uncertain. It was employed, for one or other of these reasons, in the Middle Ages.

More difficult to explain is the discovery of the nitrogenous value of such substances as "cony-clippings," hair, shavings of horn, or woollen rags. Their effect is so slow that it might be imagined that it would escape detection. Yet they appear in the 17th century lists of manures, and, as has been noticed, were bought by Hertfordshire farmers from London salesmen in the first half of the eighteenth century.

Seaweed was extensively used in counties where it was accessible, and in South Wales the practice is especially noticed. Another nitrogenous manure available in maritime counties was fish-waste, such as the "putrified pilchards" suggested by Sir

Hugh Plat. Memory of smells is peculiarly tenacious. Those who have once experienced the stench of sprats on fields in the Isle of Wight, sixty years ago, have not forgotten it. For more inland counties there were slaughter-house refuse and dried blood. The valuable properties of malt-dust were, as the lists show, early appreciated and more generally available.

Seventeenth century writers provided farmers with a considerable choice of nitrogenous manures. They were less rich in their suggestions of substances containing either phosphoric acid or potash. Possibly "snaggreet," the shelly deposit which is mentioned by Child and Blith, may have been mainly valuable as a phosphatic manure. Some phosphates would also be contained in Cornish sea-sand. Otherwise bones were the only available substance. Traditionally their value was observed by a Yorkshire master of foxhounds on the grass surrounding the kennels. At first they seem to have been roughly broken by hand labour on the farm. But by the middle of the 18th century it had become a trade to grind bones for agricultural use, and the value of boiling or steaming them was also recognised. Their use, as has been noted, was recommended by Blith in 1653, and similar advice was given by subsequent writers in the 17th century. The discovery of coprolites by Professor Henslaw (1845) in Cambridgeshire is comparatively recent.

For potash, farmers depended entirely on ashes. Their use is recommended in all the early lists of manurial substances. Some evidence exists to show that an industry was established for their production and supply. Thus William Ellis, the Hertfordshire farmer, speaks of a potash kiln in Buckinghamshire. It is also on record that, in the 18th century, Kentish hop-growers organised a system of collecting the wood-ashes of neighbouring cottagers. Essential though potash is, it is especially valuable in its effect on some of the crops which were the latest comers in English agriculture, such as mangolds and potatoes. The field cultivation of potatoes, recommended by John Forster (1664), but not practised outside Lancashire on any extended scale till the last century, has owed much of its later development to the discovery of the Stassfurt deposits.

Live Stock.—The illustrations given from agricultural writers of the 16th and 17th centuries, show that many of the triumphs of modern farming had been anticipated. The materials were already collected for the great agricultural advance which took place in the last forty years of the reign of George III. It may be added that, as early as 1645, the neces-

sity of securing to tenants the value of their unexhausted improvements had been pleaded. Where so much had been anticipated, one omission on the part of the "Rustick Authours" is striking. There is scarcely any suggestion for the improvement of live stock. On this side of their subject, writers are meagre and inadequate. None of them discuss the subject with any completeness, or with much regard for varieties of breed or for the different purposes for which animals are bred. Worlidge's *Systema Agriculturæ* (1669), for instance, passed rapidly through five editions. But the subject "of Beasts" is dismissed in 3 pages, while 106 pages out of the total number of 217, are devoted to trees, orchards, gardening, bees and silkworms. The neglect of stock-breeding and stock-rearing was not unnatural, so long as little fresh meat was eaten, and so long as winter keep was short, and the stock herded promiscuously on commons or in common folds. But as the first half of the 18th century drew to a close, the practical obstacles were to some extent removed. The market for fresh butcher's meat improved. Farms in separate occupation multiplied. Roots and temporary grasses were creeping into the rotations. When once the improvement in stock-breeding began, it spread with the utmost rapidity. Perhaps farmers adopted the principles laid down by Robert Bakewell (b. 1725; d. 1795) with the greater enthusiasm, because they were the first improvements initiated by one of themselves. The movement owed nothing to book-farmers. It met the needs of a growing demand and afforded an outlet for the natural bent of the genius of English agriculturists.

Drainage.—Drainage was the only other essential to farming progress which still lagged behind. It had been sensibly discussed by Walter Blith in 1649 and 1652. But the Cromwellian Captain and Puritan, who brings Scripture to enforce his argument, commanded none of the modern appliances. Otherwise, the inauguration of the movement for improved live stock completed the necessary preparations for a great agricultural advance.

In the progress of the 19th century Science played the most conspicuous part. Its continued aid offers the only reasonable hope of increased prosperity in the future. Its advice has been purged of the faults which originally brought book-farming into disrepute. But the history of agricultural literature in the times of the Tudors or the Stewarts is at once an exhortation and a warning to 20th century farmers to keep their eyes open.

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SCIENCE AND THE FARMER.

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THE makers of new science have often been reproached for thinking more of knowledge for its own sake than of "the relief of man's estate." That this reproach is in general unjust may be proved by an appeal to history, for it is quite certain that most of the more striking inventions that have profoundly changed the life of man have sprung from very abstract researches. First light, and then fruits, as Bacon said. The search for *Principles* always pays. But there is another answer to the unjust reproach, and that is to point to the ever-increasing body of new knowledge which has direct practical applicability and yet is left unutilised. A perusal of the stimulating Report which Mr. V. E. Wilkins has recently drawn up for the Ministry of Agriculture* shows what a wealth of useful knowledge there is which is not in general circulation: for here we find scores of discoveries of obvious practical value to the farmer which are not being applied except by a few. This is partly because we are in many departments of life in process of transition from the empirical to the scientific; it has not become natural to the farmer to seek expert advice except from the veterinarian. It is all too characteristic of the Briton to stick to methods that yield *tolerable* results, instead of pressing on to new-fashioned ways which promise something much better. Another reason for this Gallio-like indifference is that in days past valuable research was often, as it were, tied up in a napkin of technicality and hidden in the ground of a blue book. But we have changed all that. The record of recent scientific achievement which Mr. Wilkins has written is as clear as crystal and as interesting as a novel. It is a hand which science stretches out and it is for the farmer to grip it. When he does so he will find his reward.

The philosophy of the subject is plain. The nation's higher progress (in the life that is more than meat) depends on improved health and increased wealth. But more wealth means greater command of the resources of nature, and the chief of these is food. The farmer is the fundamental food-producer, and thus progress largely depends on him. But British Agriculture is

* Agricultural Research and the Farmer: A Record of Recent Achievement. Published by H.M. Stationery Office, Imperial House, Kingsway, W.C.2. Price 2s. 6d. net; obtainable through any Bookseller or direct from the Publisher

passing through hard times, and therefore Science steps in with suggestions which will enable the farmer to get better results with less expenditure of time and energy. We grant at once that other remediary measures are necessary, but here is an obvious one—how to be wealthy by being wise! Everyone wishes to succeed, to get some way on, to have production speeded up: and the Ministry of Agriculture meets this desire with the suggestion—" Try some of our patent scientific levers." It is a fair offer and one that may be trusted. Even if there be a difference between what can be done in the station at Rothamsted and what can be done on a farm at Rothiemurchus, it is for the farmer to meet the scientist frankly and show where the hitch is. Empirical lore is often marvellous, but it will lose nothing by joining hands with scientific research. Indeed, it is sure to gain.

Let us take a few instances of the new knowledge which promises new power. The soil is fundamental, of course, but the days of soil fatalism are long since past. To Dr. Russell and his school we owe a knowledge of the ways of making the soil young again when it grows exhausted, and of making it whole when it turns sick. For the soil is living to a degree that Liebig never suspected. Farmyard manure is becoming scarcer—thanks to motor transport—but there is plenty of straw. So the bacteriologist steps in and harnesses two kinds of bacteria to the task of rotting the straw. How well they do it may be inferred from the fact that an experimental plant has been devised capable, it is believed, of turning out 2,000 tons of straw manure per annum, at a cost probably under £500. This is just one example out of many; we might refer to experiments on green manure, on making crumbly soil, and on curing acidity. We would rather emphasise the stimulating idea of scientific control. Tilth is something of a mystery; analyse it—discover what it actually means, physically and chemically—and a new day dawns: it can be controlled. The new work has also brought into prominence, as we said, a new idea:—" The soil is no longer looked upon as an inert mass of mineral particles; it is a great living complex, teeming with countless millions of living things each struggling for existence, and each having some influence on those complicated chemical changes on which the growth of all plants depends, and which in the course of ages have turned a stratum of bare rock into something approaching a vast chemical laboratory."

Just as the synthetic chemist has been like a conjuror shuffling the cards of Carbon, Hydrogen, Oxygen, Nitrogen and so forth,

and producing the most extraordinary "hands" or novel carbon-compounds; so the breeder, since Mendel taught him the trick, has been able to produce new combinations which have made the world richer. Metaphorically he grafts on new characters of value and prunes off old characters that are detrimental, and so we get Yeoman wheat from Professor Biffen of Cambridge, Plumage Archer barley from Mr. Beaven of Warminster, and Blue Cone wheat from Professor Percival of Reading. We may almost speak of the creative biologist, though he is really not more than the architect of the materials which are provided by Nature. "A wheat giving a slightly increased yield, or better able to withstand the weather conditions of this country, puts money in the pockets of the farmer, and by increasing home production and thereby lessening our dependence on the foreigner, is a national asset." The story of plant breeding is a romance, but it is also a recipe-book for getting rich. Take one of the least sensational inquiries, the Welsh study of the kinds of oats suited for different altitudes. There are varieties in common use among the farmers, but these turn out to be mixtures of different strains, and therefore apt to be disappointing. What the Aberystwyth Station is doing is separating out these strains and selecting the best, which will then form the material for further improvement by breeding. When this is done each farm will be able to secure the seed best suited to the local conditions. The same thing is being done with the more intricate problem of pasture grasses.

With a better understanding of the soil is associated a better understanding of the living plant, and botany comes to the farm, inquiring into the factors influencing crop yield, the meaning of the mysterious quality of immunity to fungoid disease, the possibility of stimulating cereals with electricity, and so on down to details like the cause and cure of the "mealiness" which develops in apples and pears that have been stored too long. It is safe to predict that in years to come the farmer and the physiological botanist will be close friends, with much to say to one another. There is the plant-pathologist too, with his advice on "finger-and-toe," potato "scab," "bunt" in wheat, and all the terrible list of plant-diseases, including, of course, those like "big bud" which are due to animals. Progress towards eradication and prevention seems to be very slow; but the life-histories of many pests are being unravelled and control is bound to follow. What has been achieved (we do not think the word too strong) of recent years is outlined in Mr. Wilkins' report; we wish to emphasise the fact

(commonplace, if you like, yet not vividly recognised) that *the days of submission to disease are over.* The Research Institute on Plant Pathology at Rothamsted is, we understand, able and willing to act like a medical advisory centre diagnosing disease, and suggesting such remedies as the state of science can conscientiously recommend. In all this there is great gain. There is a socialising of science (perhaps more advanced in agriculture than in any other field), and there is a transition from empirical lore, of which we speak appreciatively, to scientific control.

This country is deservedly famous for its cattle and sheep, but there is no reason to believe that the output of meat is anything like what it might be. Moreover, the bill for imported feeding stuffs is far too heavy, amounting in 1919 to nearly sixty millions sterling. Hence the importance of the Animal Nutrition Institute at Cambridge and the Rowett Research Institute at Aberdeen. Nothing but patient experiment can determine what protein foods, for instance, are most profitable, and what proportions are best. An excess may be positively injurious as well as wasteful. Only in well-equipped institutes can security be reached in regard to such a subtle thing as digestibility; and the energy requirements of an animal can only be guessed at without the use of a calorimeter. We have personal experience to help us in regard to our own energy-requirements and capacities for digestion, yet we are continually making mistakes; how much more likely are we to err in regard to stock into whose feelings we cannot enter!

Another question of profound interest concerns the minute "accessory food substances" or vitamins which are known to play an essential part in the health of man and beast. The subject is still very young, but it seems that cases of slow growth, digestive troubles, and lack of vigour are sometimes due to monotony and artificiality of diet. Thus the Cambridge workers showed that rye alone was an entirely unsatisfactory food for young pigs, but was thoroughly wholesome when supplemented by a handful of grass per day. Similarly, the Aberdeen workers found that the so-called "rickets" of pigs depends not so much on a deficiency of vitamins, as on a lack of mineral matter. All these questions are intricate; they demand scientific precision; but they all mean money, and even on this ground only they are more than welcome.

There is, however, reproduction as well as nutrition to be considered in enlightened animal husbandry. The see-saw of life is between the two. Thus there are important researches in progress which are inquiring into the occurrence of "heat"

in young heifers, into the factors controlling the formation of milk, and into the wastage of reproductive activity that is apt to occur in such domesticated animals as pigs, sheep, and rabbits.

The Mendelian experimenters, in Cambridge in particular, continue to give most of their attention to such types as rabbits and poultry, for these are relatively inexpensive and breed rapidly. When secure conclusions have been reached on the phenomena of heredity in these cheaper types, they will be applied to cattle and sheep. There is, of course, much knowledge already available, and it is rapidly increasing. If the farmer wishes to know how to prevent the occasional recurrence of red calves in his highly-pedigreed Aberdeen-Angus breed, he has only to apply to the Mendelian expert, or to think out Mendelism for himself. Or if the poultry-breeder wishes to tell *at hatching* the sex of his chicks, there is no difficulty in doing this when silver hens are mated with gold cocks, and in several other cases. There is money here too, for the breeder can kill off his unwanted cockerels at hatching, and rear double the number of pullets with the same plant. It is impossible to conceive of farmers not being interested in the clearly-expressed indications which Mr. Wilkins gives of the breeding-researches in progress in centres like Cambridge and Edinburgh, *e.g.*, the endeavour to improve the quality of Blackface wool, or to sift out coloured hairs from the fleece.

With healthy stock there is always something doing, but sickness blots out the sun. So we turn with expectation to the section of "Agricultural Research and the Farmer," which deals with animal diseases. There we find, as we knew we should, that science continues to tackle the hydra-headed monster which seems never to accept defeat. Thus the Royal Veterinary College in London has been experimenting with a vaccine treatment of the "joint-ill" which carries off many young foals; with a serum treatment of contagious abortion in mares; and with contagious inflammation of the udder in cows. Needless to say, solutions are not picked up like blackberries, but the point is that the days of folded hands are quite over, and that the conquest of disease goes on.

Just as the Aberdeen investigators of "Isle of Wight" disease in hive-bees recently had their reward in the discovery of a trachea-blocking mite, so in regard to other parasitic diseases of other and larger domesticated animals there is progress to report. Thus there has been a successful clearing up of the life-

history of the round-worm which causes scouring in sheep and of another which lives in the intestine of fowls. It is very much to be desired that something definite should be discovered in regard to the lamb tapeworm, which appears so soon after birth. Its life-history seems to be peculiarly difficult, and here is a case where co-operation between sheep-farmer and parasitologist might yield results of national value. We cannot afford to leave any important parasite in the dark.

We have not nearly "sampled" the whole of "Agricultural Research and the Farmer"; we have not touched, for instance, on the chapters dealing with fruit-growing and with dairying. We hope we have said enough in our appreciation to excite some interest and expectancy. Frankly we must confess to some enthusiasm over this record of scientific achievement, for we had not quite realised the cumulative effect of a multitude of new researches all converging on "the relief of man's estate," as Bacon phrased it. The biological control of life is here in progress before our eyes; and we submit that it should make the eyes of the farmer glad.

Here is a treasury of new knowledge and the Open Sesame is half-a-crown to His Majesty's Stationery Office. We have not had more interesting or more cheerful reading for many a day than this story "Agricultural Research and the Farmer" It was, if an outsider may say so, a happy thought on the part of the Minister of Agriculture to devise such a record, and it has been accomplished by Mr. Wilkins with masterly workmanship. We should like to suggest several ways in which its value might be brought home to the farmer.

(1) We are not fond of the saying "seeing is believing," but perhaps the reality of the new researches would be more widely appreciated if there were more opportunities for visiting the Experimental Stations to see things actually happening.

(2) Perhaps more might be made of the Shows and Conferences, where results could be exhibited so that he who runs might read.

(3) No one would wish to interrupt a maker of new knowledge, but there is no doubt that an address from one of the discoverers about his own discoveries is very highly appreciated and never fails of far-reaching effect. It might not be altogether detrimental to the discoverers themselves if such educational excursions were less rare. We know, of course, the splendid expository work of the Universities, Colleges, Stations, and County Organisers, but there is incalculable value in personal contact

with the men who are actually making the new science. The Lieutenant is often admirable, but the farmers wish to meet the General. It is in such meetings that some enthusiasm is created, which may lead, for instance, to symposia in which the farmers can thrash out things for themselves, perhaps with a Professor of Agriculture as a referee.

It is impossible to think of a winter-afternoon exercise more profitable intellectually and pecuniarily than going through a book like "Agricultural Research and the Farmer." And it adds to its own merits by giving a guide to detailed literature.

It often looks as if there were some serious flaw in the connections which should bind the scientific expert and the farmer in co-operation. Perhaps this is in part due to the superiority of the pioneer scientists who queered the pitch by finding no place for the empirics, who retaliated by having no use for them! The day for this is past. In many cases the empirics were and are quite marvellous, sometimes reminding one of physicians born with a flair for diagnosis. All the surviving lore of the old farmers is valuable, as long as it is not superstitious. Yet it requires to be rationalised and illumined, and the long and short of it is that *scientists and farmers cannot afford not to join hands* In active co-operation in the quest for new knowledge mistrust will disappear and mutual appreciation will grow.

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THE SCHOOL OF AGRICULTURE OF THE UNIVERSITY OF CAMBRIDGE.

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AGRICULTURE has been a subject of academic study in the University of Cambridge for less than 30 years. Nevertheless it is by no means an easy task to describe precisely the earlier stages of its development. Like most of the newer departments of the University, the School of Agriculture in its present form has grown up gradually from small beginnings.

Informal Beginning.—A windfall to the Exchequer, the foresight of a Minister of Agriculture, and the persistence of a small committee of enthusiastic members of the University and of the neighbouring County Councils assisted at its birth. A hard-working staff, backed by the prestige of the University, and

nourished by private benefactions and by increasing grants from County Councils, from the Ministry of Agriculture, and from the Development Commission, have succeeded in establishing it in its present position.

The writer, who has been connected with the School for 28 years, welcomes this opportunity of setting out in the following paper his impressions of the development of the School in the past and his idea of the part it may hope to play in the future.

When he made his budget in the spring of 1889 the then Chancellor of the Exchequer expected a licensing Bill to pass in the next session of Parliament. This Bill included a provision for extinguishing certain licences, and in order to provide a fund for compensating the holders of these licences the Chancellor put an increased duty on spirits. The Bill being subsequently defeated, the Chancellor was left with an unexpected surplus which was handed over to the newly-created County Councils to be used for Technical Instruction.

Many of the County Councils decided to spend part of their Technical Instruction grant, or "whisky money," as it was commonly called, on Agricultural Education, and at once a great demand arose for Agricultural Teachers, a demand which the existing agricultural teaching institutions were unable completely to supply.

The President of the Board of Agriculture at that time Mr Henry Chaplin, now Viscount Chaplin, foreseeing that a deficiency of trained agricultural teachers would jeopardise the success of the campaign of agricultural education which his Board desired to foster, wrote to the Chancellor of the University, the late Duke of Devonshire, a letter dated 25th July, 1890 This letter contained what the writer believes to have been the first suggestion that a Department of Agriculture should be founded in the University of Cambridge. It was communicated by the Chancellor to the University, who at once appointed a syndicate to consider the suggestion and to report on its possibilities

After nearly two years of discussion the syndicate presented to the University its report, which recommended the creation of a Department of Agriculture on a scale which the University were unable to accept for lack of adequate funds

The Syndicate, however, did not accept defeat, but set to work to prepare a less ambitious scheme, of which more anon. Meantime one of the members of the Syndicate, Professor Liveing, head of the Chemical Department, had in the long vacation of 1891, organised under the late Mr. Henry Robinson, of Downing

College, who had spent some time at the Royal Agricultural College, Cirencester, a class for senior students who proposed to take up agricultural teaching. This class, which to the best of the writer's belief was the first agricultural class held in Cambridge, was attended among others by Professor John Percival, of Reading, Mr. R. H. Adie, now Secretary of the School of Agriculture, Mr. Cecil Warburton, Zoologist to the Royal Agricultural Society, and the writer. The instruction was not exactly systematic, but much valuable information was obtained by visits to Rothamsted, Woburn, Sawbridgeworth and other centres of agricultural interest.

At the same time, Professor Liveing, and Professor Hughes, head of the Geological Department, had begun negotiations with representatives of a number of neighbouring County Councils, among whom were Mr. Albert Pell of Northamptonshire, Mr. Arthur Sperling of Cambridgeshire and Mr. Howard Coote of Huntingdonshire. These gentlemen constituted an informal Committee, the Cambridge and Counties Agricultural Education Committee, which was assisted in its deliberations by the late Mr. A. E. Brooke-Hunt, Educational Inspector of the Board of Agriculture. With the aid of a small capital grant from the Cambridge County Council for equipment, and small annual grants from that County Council, from other neighbouring counties, and from the Board of Agriculture, this Committee began in January, 1893, to give an organised course of instruction in agricultural science. Professor Liveing was Secretary and Treasurer of the Committee, Mr. Albert Pell, Chairman, and Mr. Henry Robinson the only full time officer. Headquarters were in rooms lent by Professor Liveing in the basement of the chemical laboratory, where Mr. Robinson gave lectures and practical classes in agricultural chemistry. Professor Hughes gave a special course of lectures on agricultural geology, illustrated by frequent field excursions. Agricultural botany was taught by Mr. I. H. Burkill, of Caius College, now Director of the Botanic Gardens at Singapore. There were seven students, all scholars of one or other of the contributing County Councils. Only two of them were members of the University. The Committee maintained a room in St. Mary's Passage as a reading room and library. Meantime, the second report of the Syndicate, recommending the institution of a Diploma in Agriculture, was accepted by the University in November, 1893, and the first Diploma was awarded in July, 1894, on the results of examinations held in that month.

This was the state of things when the writer returned to Cambridge as successor to Mr. Henry Robinson in January, 1894, his duties being to act as Secretary to the Committee, to teach agricultural chemistry, and to supervise three manurial experiment stations, which had been established by neighbouring County Councils, namely, Higham and Lavenham in West Suffolk and Bramford in East Suffolk. The latter was notable as the only station in the writer's experience where phosphatic manuring failed to produce any appreciable effect even on the turnip crop.

Financial Difficulties.--For some time financial support from the Counties was so fitful that the Committee repeatedly found itself in financial straits, and on one occasion in 1897 Professor Liveing, the Treasurer, called a special meeting at his house at which the winding up of the Committee's venture was seriously discussed. In the course of the next year, however, largely through the instrumentality of the Cambridge County Council and the personal efforts of the late Mr. Austin Keen, its Organising Secretary for Education, county contributions were put on a more permanent footing, the County Councils of Cambridge and 9 other neighbouring counties agreeing to contribute annually a definite percentage of their Technical Education grant, and to appoint two representatives on the Committee. The Committee agreed to accept scholars from these counties on favourable terms, to supervise local experiment stations, to provide summer courses for elementary teachers, and to supply local lectures in the counties, the last two items in collaboration with the Local Lectures Syndicate of the University. This arrangement provided an annual County Council subvention of about £750, which through the good offices of the late Mr. A. E. Brooke-Hunt, the very sympathetic inspector of the Board of Agriculture, was suppplemented by an increased Government grant. This proved to be the turning point of the development of agricultural education in Cambridge—the record from that time is one of continual development.

In 1896 the University had received its first benefaction for agriculture in the form of the endowment for 21 years of a Lectureship in the History and Economics of Agriculture by the late Sir Walter Gilbey. Its increased permanent income also enabled the Committee to appoint in 1897 an experimental assistant to take charge of the supervision of local experimental work.

During the years 1896 to 1899, progress was steady The number of students rose to 20. The increased staff found time

for a certain amount of research both in the laboratory and in the field. The number of local experiment stations in 1899 had risen to over 50, scattered widely throughout the contributing counties, and plant breeding experiments had been begun in a small garden behind the Cambridge Technical Institute in East Road lent by the Joint Education Committees of the County and Borough of Cambridge.

Formal Foundation.—It was at this stage that the University took over the control of agricultural education from the Cambridge and Counties Agricultural Education Committee. The events which brought about this important step are of some interest. In 1898, Sir Walter Gilbey offered to the University a second benefaction, a capital sum sufficient to maintain for 10 years a lectureship in some branch of technical agriculture or agricultural science. The fact that this offer was accompanied by the condition that the University should recognise an examination in agriculture or agricultural science as an avenue to a degree caused somewhat prolonged negotiations. Whilst these negotiations were proceeding the University received an offer of a third benefaction—from the Worshipful Company of Drapers—of the endowment for 10 years of a Professorship of Agriculture, on condition that the University would found and maintain a Department of Agriculture and would recognise agriculture or agricultural science as a subject of study for a degree.

Both these generous offers were accepted in the early months of 1899 and the University took over the work of the Cambridge and Counties Committee as a going concern, the financial arrangements being greatly facilitated by the promise of an increased annual grant from the Board of Agriculture. A Board of Agricultural Studies was created to conduct the teaching and examining, and both the Cambridge and Counties Committee and the Agricultural Examinations Syndicate were dissolved. The diploma examinations were remodelled and the University recognised the first examination as a special examination for the ordinary B.A. degree.

The Drapers' Professorship of Agriculture.—In the autumn of 1899 Professor Somerville was elected as the first Professor of Agriculture on the Drapers' foundation, and the newly constituted Department of Agriculture began work in October, 1899, with a full time staff consisting of Dr. Somerville as Professor of Agriculture, the writer as Lecturer in Agricultural Chemistry and Secretary, and Mr. R. H. Biffen as Lecturer in Agricultural Botany. This staff was housed in four

small rooms in the basement of the University Chemical Laboratory lent by Professor Liveing, and in a small room in the Botany School lent by Professor Marshall Ward.

Within a year a farm of 140 acres was added to the equipment, Burgoyne's Farm, Impington, 5 miles from Cambridge, being leased to the University rent free for 10 years by the late Mr. W. A. Macfarlane Grieve of Clare College. The farming capital of £1,500 was collected by public subscription.

Under Professor Somerville this farm was stocked and equipped, local experimental work was extended by the establishment of several experiment stations on a more permanent and ambitious scale, notably the "manuring for mutton" stations at Hatley, Cransley, and Trowse, and the "schemes of manuring" stations at Saxmundham, Hatley, Great Thurlow, and Thriplow. Laboratory research was also actively prosecuted, chiefly in the direction of studying the composition of various crops. Biffen's plant breeding work, endowed with a new weapon by the rediscovery of Mendel's laws of heredity made steady progress. The teaching was reorganised by the inclusion of systematic instruction on the practical side of agriculture, and the number of students slowly but steadily increased.

In 1902, Professor Somerville left Cambridge in order to fill the important position of Assistant Secretary in charge of the Intelligence Division of the Board of Agriculture. During his short stay his personal gifts and the success of his practical experiments had made an important contribution towards the establishment of the new department as one of the scientific departments of the University. He was succeeded by Professor (now Sir Thomas) Middleton, who, like his predecessor, left the chair of agriculture at Armstrong College, Newcastle-on-Tyne, to come to Cambridge.

Professor Middleton extended the experimental work inaugurated by Professor Somerville by including in the farm programme a very comprehensive series of variety trials of oats, potatoes, mangolds and other farm crops, and in collaboration with the writer, at that time Reader in Agricultural Chemistry, carried out an important series of feeding trials at several centres to test the nutritive value of different varieties of mangolds. Research work on the composition of crops was actively prosecuted by the writer and his assistant, Mr. R. A. Berry, now Professor of Agricultural Chemistry at Glasgow, and by Mr. Biffen on plant breeding. The steady increase in the number of

students was maintained, and a number of men entered for the final Diploma course after having taken an honours degree in Natural Science. Such men readily obtained good positions in India and the Colonies, and Professor Middleton's Indian experience was an important factor in encouraging a class of students of this type.

As the number of students increased it became evident that the department was outgrowing its temporary home in the chemical laboratory, and the need of a permanent agricultural laboratory became pressing. The first step was taken at the Royal Agricultural Society's show at Derby in 1906 when His Majesty King Edward VII, who was staying with the late Duke of Devonshire, Chancellor of the University, visited the show and expressed great interest in the Department's exhibit of new varieties of cereals in the Education building. The Duke soon afterwards consented to act as chairman of a special committee of the Cambridge University Association with the object of collecting £20,000 to build an agricultural laboratory, the University having promised to provide a site adjoining the other scientific laboratories and museums. The Worshipful Company of Drapers, whose munificence had already created the Professorship of Agriculture, headed the subscription list with the offer of £5,000 on condition that an equal sum should be promised immediately. This condition was fulfilled at the first meeting called in London by the Committee. Very soon afterwards, the Duke of Devonshire, who had initiated the scheme, died. His place as chairman was taken by the present Duke, to whose energy the ultimate success of the scheme was due.

Meantime Professor Middleton, like his predecessor in the Chair of Agriculture, accepted an Assistant Secretaryship at the Board of Agriculture, which made it necessary for him to leave Cambridge in May, 1907. He was succeeded by the writer, whose appointment necessitated a considerable reorganisation of the Department. Professor Middleton had taken charge of the teaching of Agriculture and the direction of the farm. The new Professor continued his teaching of agricultural chemistry, and the agricultural teaching and the farm were put in the hands of Mr. K. J. J. Mackenzie, who had been Vice-Principal of the South Eastern Agricultural College.

A few months later, the Drapers' Company gave further evidence of their great generosity by increasing their annual grant and renewing it for a second period of 10 years to 1919. This enabled the University to create a second agricultural professor-

ship, and Mr. R. H. Biffen, whose distinguished work on the improvement of cereals had already begun to achieve practical success, was elected Professor of Agricultural Botany in the spring of 1908.

The New School of Agriculture.—Meantime the Duke of Devonshire's committee had continued their efforts, and in the autumn of 1909 the University Association was able to hand over to the University the sum of £20,000. The University assigned a site adjoining the Botany School and the Sedgwick Museum of Geology, and appointed a syndicate to supervise the erection of the building. The preparation of plans was entrusted to Mr. Arnold Mitchell, F.R.I.B.A., and the contract for the erection of the building was given to Mr. William Sindall of Cambridge. The School of Agriculture was formally opened by the Duke of Devonshire on 26th April, 1910, though the staff and 40 students had been in occupation since January The building has proved satisfactory in every way and reflects great credit on both the architect and the contractor. Its total cost was about £17,500. The balance of about £2,500 was invested by the University, the income being applied to the payment of rates and maintenance.

(To be concluded.)

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FARM BUILDINGS FOR SMALL HOLDINGS:

VARIATIONS FROM THE NORMAL.

MAJOR H. P. G. MAULE, D.S.O., M.C., F.R.I.B.A.

IN a previous article* a description and illustrations were given of a type of building with a single span roof for a 50-acre mixed holding, and it was suggested that if this type proves successful in practice further development might take place on similar lines. One of the objects of these articles is to draw attention to any new methods of planning and construction or any variant of an old method in order to elicit opinions on their merits or demerits, with a view to future improvement and evolution.

* Farm Buildings for Small Holdings: A West Riding Improvement, this *Journal*, May, 1922, p. 113.

There can be little doubt that reform is needed in the planning and detail of new buildings, and perhaps more particularly in the reconditioning and adaptation of existing ones. Moreover, the present economic situation is such that any new building or adaptation work dictated by the necessity for improved returns must be carried out with the strictest attention to capital outlay, as well as to the cost of annual maintenance. It is therefore of real importance in the interests of practical farming that full publicity should be given to any new idea or variations from the normal, in order to separate the wheat from the chaff and to arrive at any definite facts which will assist both farmers and architects to solve the building problems of the future.

This article deals with two other variants from the main normal types of 30- to 50-acre holding buildings referred to in the previous article and has a twofold object: (*a*) to compare the West Riding Single Span Scheme with buildings now illustrated, and (*b*) to suggest that the types discussed here may be a valuable guide in certain kinds of adaptation work.

Figs 1 and 2 illustrate buildings on a 20-acre mixed holding, erected by the North Riding County Council, and show all the various departments of the farm grouped under a single roof.

The main difference from the West Riding type is (1) that no real covered stock-yard is included under the roof, only a cattle shed of very small dimensions, which, however, might presumably abut upon an open yard if desired; (2) that the centre of the upper part of the building is constructed as a loft giving ample floor space for the storage of hay, grain, cake, etc., and with access provided from the mixing floor below. In appearance the building is very similar to a south country straw barn, and it is this construction which suggests that the latter might in many cases be converted to a complete range of buildings at comparatively small cost and with profitable results.

The root store and mixing floor is placed centrally on the north side with exceptionally easy internal access to all parts of the building, and for direct and simple labour-saving planning the scheme in this respect is difficult to improve. The cow byre is placed centrally to the south with a feeding passage between it and the mixing floor, and with direct external access. There is also direct external access to both stable and loose box.

In comparison with the West Riding Scheme it must be noted that the acreage of the latter holding is considerably greater, and that the type of construction is fundamentally unlike. The

provision of the loft immediately above the greater part of the area devoted to stock contrasts with the open roof of the West Riding Scheme, and it is the effect of these different treatments which it is essential to know. If the results are satisfactory it is not too much to say that a valuable contribution has been made both to the planning of new buildings and the adaptation of old ones. Here again what is now needed is some record of the actual working results. If it is found in practice that the health of the stock does not suffer from over concentration in the effort to obtain a labour-saving plan, it is obvious that further development on these lines might well be found to be suitable to larger buildings for an increased acreage.

It is sometimes difficult to know how to make the best use of old timber-framed straw barns, which are often in an excellent state of structural repair, or possess the probability of a long and useful life if adequately repaired or re-roofed. In general dimensions and appearance many are very similar to the North Riding Scheme and could be easily and economically sub-divided upon the lines indicated.

Figs. 3 and 4 show the equipment of a 30-acre holding on the Stockton Grange Estate of the Durham County Council and show a very simple arrangement as far as plan is concerned, but a very different method of roof construction.

In convenience of ground plan there is little to choose between the two schemes, the transposition of the stable and loose box being comparatively unimportant and probably governed by the nature of the site and approaches. The chief difference in plan is the position of the granary, here placed solely over the cart shed by raising the roof at this point (*see* Fig. 4).

The roof has been constructed in the form of two parallel small single spans with a long gutter between carried over the central dividing wall, the granary as already stated being roofed at a higher level over the cart shed. It can, the writer thinks, be shown that a single span roof of modern construction could be built more economically in initial outlay than by the method selected and without the expenditure in annual upkeep of the long gutter between roofs, always a source of trouble and expense, and particularly so in the neighbourhood of stack-yards. It may be that a single span roof was discarded on the score of exposed situation or because it was considered undesirable to put any floor over the heads of the live stock. If the latter is the true explanation it is again a point which can only be determined by careful observation and continued practice, and the architect must be guided by the practical farmer.

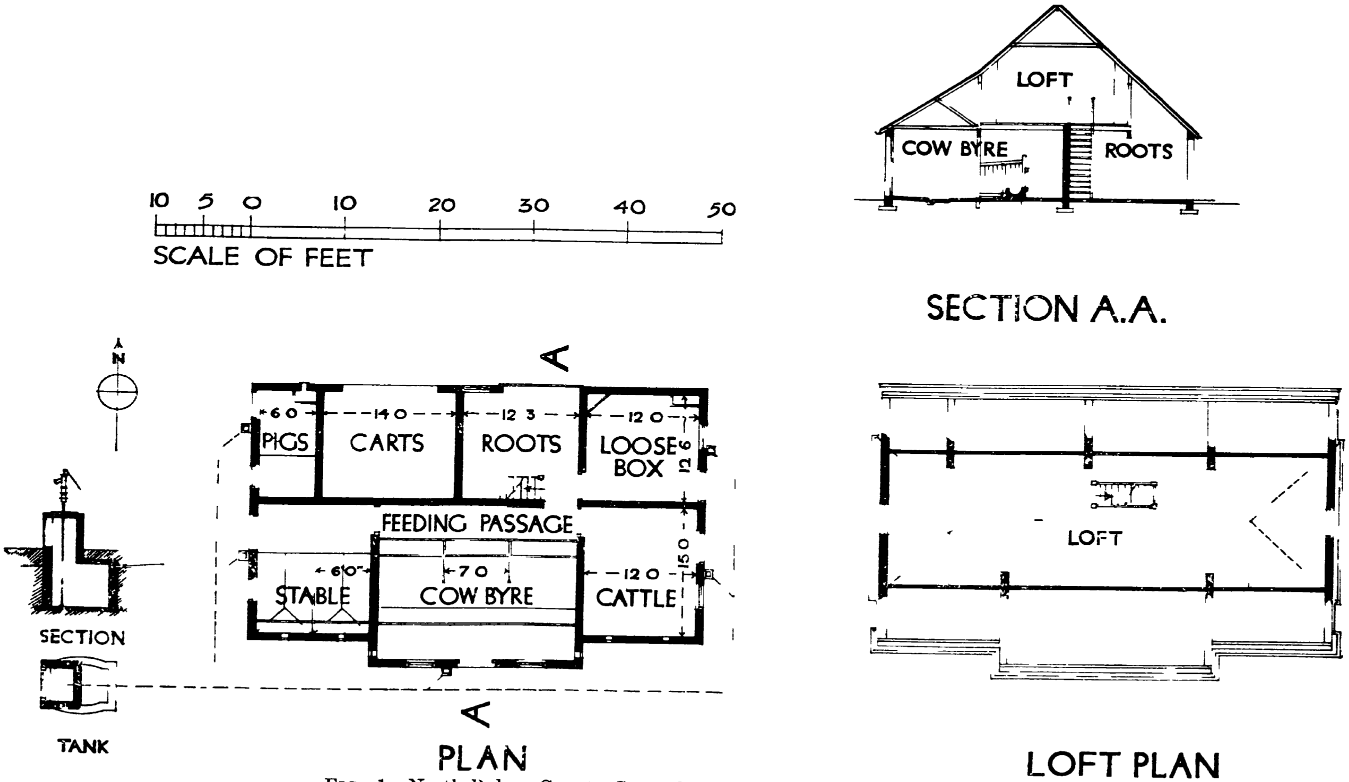

FIG 1—North Riding County Council. 30-acre Holding, Farm Building

FIG. 2—North Riding County Council. 30-acre Holding Farm Building.

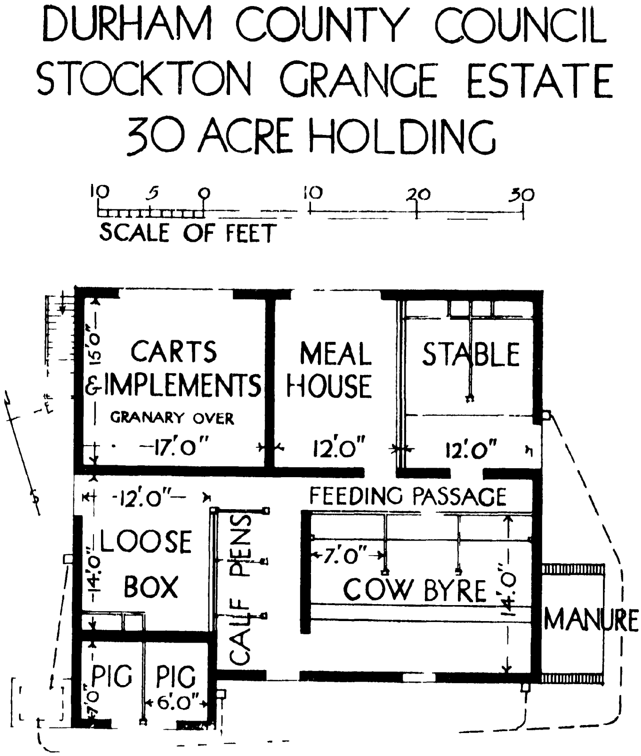

FIG. 3. Plan of Farm Buildings.

FIG. 4.—General view of Farm Buildings from the South.

If a covered yard is of such great importance both for increasing the head of stock and for the production of the best grade of manure as we are inclined to think, then it would appear that the West Riding type should give the best results on both counts, particularly in an exposed situation where increased shelter and warmth are imperative. If, also, it can be shown that the provision of a loft over stock is not detrimental, provided adequate ventilation and cubic space are given, it would appear that the North Riding Scheme, with the single roof and large loft is the more advantageous of the two described in this article for smaller holdings where the West Riding type would be too costly. There is good reason to think that in the matter of cost, by careful planning and new methods of construction the single roof type might be the cheaper method and can be so constructed that there need be no fear on the score of increased annual upkeep due to exposed climatic conditions. Possibly some compromise between the North and West Riding types could be evolved giving a small covered yard as well as the loft space.

Although these two examples of concentrated planning are covered by different types of roof they may for practical purposes be regarded as the offspring of the same desire, viz.:—to reduce the labour in tending stock to the minimum. As such plans are widely different from the majority of small holding buildings erected during the past few years, and are approximate in principle to modern American and Danish methods, they may be considered of more than passing interest. This type of plan, carefully worked out, must be more economical than the open courtyard type with its increased amount of external walling and angles, gutters, down pipes, drains and larger area of ground covered, and it does undoubtedly fulfil the great principle of economy of labour in the concentration, preparation, and distribution of fodder. For these reasons these Yorkshire and Durham types are worth careful consideration, not only with regard to future small holding equipment, but also inasmuch as they represent in embryo principles which, if found successful in practice, might be extended to much larger acreages.

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PHOSPHATIC FERTILISERS.

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PHOSPHATES serve at least five purposes in the soil:—

1. They cause an earlier development of the young plant than would otherwise occur;

2. They bring about a considerable development of fibrous roots;

3. They counteract the rankness of growth which is liable to occur on land richly supplied with nitrogen compounds;

4. They hasten ripening and improve the quality of grain,

5. They increase the feeding value of the ordinary fodder crops.

They are more widely used than any other fertilisers, and the farmers of the United Kingdom alone purchase something like one and a quarter million tons each year.

Bones.—The oldest form of phosphate used on the farm is obtained from bones. In old days raw bones themselves were much used. Under modern conditions the fat and often the gelatine are first removed, these having considerable commercial value, and the residues are then ground for manure. Sometimes also the bones are treated with sulphuric acid to make the phosphates more soluble. There are thus four bone products obtainable by the farmer:—

(*a*) *Raw bones*, containing the whole of the material, including fat and gelatine;

(*b*) *Bone-meal*, containing the gelatine, but not the fat;

(*c*) *Steamed bone flour*, containing neither gelatine nor fat;

(*d*) *Dissolved bones*, being raw bones or bone-meal treated with sulphuric acid.

Typical analyses are as follows (the figures being percentage constituents):—

	Nitrogen.	*Equivalent to Ammonia.*	*Phosphoric Acid.* (P_2O_5).	*Equivalent to tricalcic phosphate.*
Raw English bones	5	6	22	48
Bone-meal	3·5–4·5	4·2–5·4	20–25	43–55
„ „ usual analysis ...	3·75	4·5	20·6	45
Steamed bone flour	1–2	1–2·5	25–32	55–69
Dissolved bones	2–3	2·3–3·8	15–16	33–35

Bone fertilisers are very safe, but they are generally less effective than the substances described below. They have not

proved as successful as superphosphate for turnips, or as basic slag for grass. Steamed bone flour, being very finely ground, has proved useful in dry situations; and bone-meal has given tolerably good results for potatoes and for other crops at Rothamsted and at Saxmundham, but at Cockle Park and Aberdeen it did not come out well. There is a belief among certain farmers that dissolved bones are better for the land than superphosphate, but no clear evidence has ever been obtainable in spite of much search for definite instances. On the whole we must conclude that dissolved bones are more popular than they deserve to be.

Superphosphate.—Superphosphate is by far the most widely used of all artificial fertilisers. It is made by treating mineral phosphates with sulphuric acid, and is sometimes therefore regarded as an " acid " fertiliser, but this is incorrect; well made superphosphate has no acidifying effect on the soil. But it is also important to avoid another common error—the assumption that the " lime " referred to in the full name " superphosphate of lime," behaves like lime in the soil and so obviates the necessity for periodical applications of true lime or limestone. *Superphosphate contains no true lime,* and the fact that it is being applied regularly to land does not in the least reduce the necessity for periodical applications of lime. What superphosphate does contain besides calcium phosphate is gypsum, and so much of this is present that the practice of using gypsum as a fertiliser, which at one time was common, is no longer recommended

Superphosphate is usually sold on its content of water-soluble phosphate, but this is expressed in terms of tricalcic phosphate, thereby facilitating comparison with other phosphatic fertilisers. Thus, when a superphosphate is guaranteed " 30 per cent. soluble" it does not mean, as is often supposed, that 30 per cent of the manure is soluble in water, or that 30 per cent. of the phosphate is rendered soluble, but that the water-soluble phosphate in 100 lb. of the manure contains as much phosphorus (the thing the farmer really wants) as does 30 lb. of tricalcic phosphate.

For Roots.—The most profitable use of superphosphate is on potatoes and on roots. For potatoes it is in practically all conditions the best phosphatic fertiliser we have, and dressings of 4, 6 or even 8 cwt. per acre are often given according to the yield obtainable. In the north (Durham, Northumberland, S.W. Scotland), it has been recommended to use a certain amount of basic slag (2 to 3 cwt.) in partial replacement of the superphosphate. It is not desirable to replace too much, however.

as potatoes are liable to scab if alkaline conditions are set up by the basic slag. Further, it is not certain that heavy dressings of phosphates are always desirable for potatoes; in Devon experiments 400 lb. superphosphate per acre gave a somewhat larger yield than did 533 lb. per acre.

For swedes and turnips superphosphate serves the admirable purpose of bringing them earlier to the hoe than would otherwise be possible. This alone often justifies the use of the fertiliser quite apart from the increase in crop and of feeding value. For these crops, however, basic slag is often equally effective in the north, though not always in the south; but it is always to be preferred wherever finger-and-toe is common.

Mangolds commonly receive a dressing of superphosphate to bring them on earlier, but as a rule there is no point in applying large dressings; probably $2\frac{1}{2}$ cwt. per acre is all that is needed. Indeed there is some evidence that too much superphosphate has the undesirable effect of reducing the growth of the bulb and hastening the ripening of the crop, *i.e.*, the formation of seed.

For Cereals.—Another highly important use of superphosphate is in hastening the ripening of cereals, this being of especial advantage in districts where the harvest is apt to be late. Thus in wet hill districts the harvest is sometimes a source of serious anxiety to farmers and there is a great advantage in expediting it, if only by 6 or 7 days. This has been done by giving a dressing of about 3 cwt. superphosphate along with a small amount (say $\frac{3}{4}$ cwt.) sulphate of ammonia, to ensure an early development of leaf.

Superphosphate is also used with advantage on barley grown after roots which have been fed to sheep on the land, especially when cake or corn have also been given. It counteracts the rankness that tends to be induced, improving the quality of the grain and increasing the strength of the straw. The same kind of action takes place when superphosphate is added to the nitrogenous top-dressing given to cereals in the ordinary corn-growing districts. Increased yields are obtained by applying nitrogenous dressings to corn crops in spring. There is, however, often the fear that the corn will be laid owing to the inability of the straw to carry more grain. Experience has shown that this tendency is frequently reduced by the addition of 1 to $1\frac{1}{2}$ cwt. of superphosphate to the dressing.

Effect of Soil and Rainfall.—As a rule dry sandy soils in the eastern and midland parts of the country, where the rainfall is

below 25 or 28 in., respond less to phosphates than the heavier soils. Thus superphosphate acts better on the heavy soils of Rothamsted than on the lighter land at Woburn. It is commonly observed on the light lands of East Kent that smaller phosphatic dressings are called for than on the heavier soils. While much depends on the soil a good deal depends also on the rainfall, and a sandy soil under 35 in. of rain will need larger and more frequent dressings of phosphate than a similar soil with 25 in. of rain. With the higher rainfall also there is more possibility of substituting basic slag for superphosphate when the soil is sour or the slag is cheaper.

Although the phosphorus in superphosphate is soluble in water it does not wash out from the soil; it becomes distributed and fixed. At Rothamsted it is possible to account for practically all the phosphate added during the past 70 years; some has gone into the crop and nearly all the remainder is still in the soil. only very small quantities having been washed away.

Basic Slag.—*On Grass Land.*—Basic slag is pre-eminently the fertiliser for grass land, whether pasture or meadow, and it has effected remarkable improvement in cases where it is suitable. It produces its most striking results on heavy land covered with poor herbage containing large quantities of "bent grass" which goes brown in autumn, giving a very parched appearance to the field. The best known instance is that of Cockle Park, where grazing capable of carrying only about 1 sheep per acre and producing only about 25 lb. of live weight increase per acre each season has been so improved that it now carries about 3 sheep per acre and produces about 100 lb. of live weight increase.

The improvement is effected through the agency of the wild white clover which begins to develop soon after the slag is applied. It is therefore essential that the conditions should favour this plant, and for this reason it is wise to adopt a bold policy and give a substantial dressing of slag at the outset. Where drainage is necessary this must receive attention, but there are instances where the wetness of the grass is due not so much to faulty natural drainage as to a mat of moss or decaying vegetation which impedes the soaking away of the water In such cases the unslagged land may remain wet while on the slagged land the mat disappears and the water gets away naturally.

It is sometimes supposed that slag acts well only if there is heavy rainfall, but this is shown not to be the case by the Essex experiments conducted by Professor G. Scott Robertson. Al-

though the rainfall is not particularly high, slag has improved the yield of hay, raising it from 10 cwt. per acre on the unmanured to 20 cwt. per acre on the slagged land in one of the poorest fields, and from 30 cwt. on the unmanured to 40 cwt. per acre on the slagged land in one of the best fields. Here also the chief improvement is in the type of herbage; the clover increases considerably, and the land is more completely covered with vegetation, with the result that its temperature is lower in summer, there is less wastage of water by evaporation, and in consequence the crop has a larger available supply of water.

Basic slag does not produce these striking results on all types of grass land. Where the herbage is already good enough to carry three, four or more sheep per acre each season there is less room for improvement; this is the case at Rothamsted, and in consequence the grazing experiments are less impressive than at Cockle Park. Similarly the yield of hay on the unslagged land is above that on most Essex slagged plots; hence the improvement is less marked. Further, on light land there is sometimes only little improvement until kainit is added; the combination of slag and kainit then gives a better herbage and larger yields, but there is not always a profit. So on hill land the value of the improvement effected by the slag does not always repay the cost to the farmer; the fault here is not always with the slag, but sometimes with the system of management of the grazing.

On Arable Land.—Although basic slag is best known for its effects on grass land it has in many cases proved useful on arable land also. In the north of England and in Scotland it is recommended for use on swedes and turnips, either in partial or complete replacement of superphosphate, especially where finger-and-toe is common. In the south and west of England it has not generally given as large crops as superphosphate, though under favourable conditions of price it has sometimes proved equally profitable.

Types of Slag.—There are at present three types of slag on the market. (1) The old Bessemer slag with which the Cockle Park experiments were carried out. This contains total phosphorus equivalent to 38 to 42 per cent. of tricalcic phosphate, with a solubility of 85 per cent. by the official citric acid test. Nowadays this type of slag is not common, but a certain amount is still produced in this country, and some is imported from abroad. It seems, however, improbable that large supplies will be maintained.

(2) The present-day open-hearth slag of high solubility containing phosphorus equivalent to 15 to 35 per cent. of tricalcic phosphate, and therefore poorer than the old Bessemer slag. There is no reason to suppose that anything except the phosphate has fertiliser value, and in comparing these slags with the old it is usual and probably sound to do so on the basis of equal phosphate content. Experiments made on these lines indicate that the phosphate in the high soluble slag has on the whole the same agricultural value as that in the Bessemer; in other words, a dressing of 10 cwt. per acre of a 20 per cent. high soluble slag could be expected to have approximately the same effect on grass land as 5 cwt. per acre of a 40 per cent. Bessemer slag.

(3) Some of the open-hearth slag, while containing the same amount of total phosphorus as the preceding material, has a much lower solubility according to the official test. It is not yet clear that there is any great difference between slags of some 60 per cent. and those of 80 per cent. solubility, but it does appear that those of 30 per cent. and still more so those of 20 per cent. solubility are less effective. In the Essex experiments the low soluble slags were less reliable than those of high solubility; sometimes they acted well and sometimes they did not. There is evidence that they are slower in action than the high soluble slags, and hence they should be given time and not expected to work in a hurry; they should be applied in autumn and used preferably in districts of sufficient rainfall. Out of 41 experiments with both types of slag coming under review during the dry season of 1921, 15 of the high soluble were effective, but only 9 of the low soluble.

The comparison of prices of slag and superphosphate is rendered easy by the circumstance that both are sold on the basis of their phosphate content, and although the actual compounds differ in the two fertilisers, they are each expressed in terms of the standard tri-calcic phosphate. Thus, as already explained "30 per cent. superphosphate" means that 100 lb. of the superphosphate contains as much phosphorus as is present in 30 lb. of the standard tri-calcic phosphate. So a "20 per cent. slag" contains in 100 lb. as much phosphorus as does 20 lb. of the standard tri-calcic phosphate. If therefore 30 per cent. superphosphate is offered at £4 5s. each unit costs 2s. 10d.; while if 20 per cent. slag is offered at £3 each unit costs 3s. The price should be worked out to include delivery at the farmer's station.

Solubility of Slag.—There is a further description of basic slag which often causes some confusion—the solubility. This figure

refers to the part of the phosphate which is soluble in the citric acid used in the official test. Thus a 20 per cent. slag of 20 per cent. solubility is a slag 100 lb. of which contains as much phosphorus as does 20 lb. of tricalcic phosphate, and that 20 per cent. of this phosphatic material is soluble in the official testing liquid. A 20 per cent. slag of 80 per cent. solubility would also contain in 100 lb. as much phosphorus as does 20 per cent. tricalcic phosphate, but, of this, 80 per cent. is soluble under the conditions of the official test. This test was designed for the old Bessemer slag and is not equally suitable for the present-day open-hearth slags; data for revision will be available when more field experiments are carried out. In the meantime farmers should regard the solubility figures as having a descriptive rather than an exact value: a slag of 70 per cent. solubility is probably quicker in action than one of 35 per cent. solubility, but it has not necessarily double the value as the figures suggest

Mineral Phosphates.—These have been used with good results in the United States under the name of rock phosphate; they have also proved effective in France. In the Essex trials they gave promising results, though up to the present they have not acted as well as the high soluble basic slag. A number of tests are in progress in different counties and the results should be carefully watched by farmers. The present indications are that fineness of grinding is important and that the value per unit of phosphate is less than in basic slag.

(This article replaces in this issue the usual notes on manures contributed to the *Journal* by Dr. Russell.)

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GREEN MANURING.

PART II.

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The Mode of Action of Green Manures.—The effect of a green manure on the succeeding crop as compared with that of farmyard manure can be considered under three heads, according to its influence on (1) the supply of mineral nutrients to the main crop; (2) the supply of nitrogen to the main crop; (3) the physical properties of the soil—tilth, moisture-holding capacity, etc.

(1) *Effect on the Supply of Minerals.*—Farmyard manure adds potash and some phosphates to the soil, and these being derived partly from feeding stuffs imported from outside the farm, are a gain to the soil. A green manure, on the other hand, only returns to the soil those mineral substances which it first took from it, so that before it can be equal in its effects to farmyard manure in this respect, it must be supplemented by mineral manures; there is, however, no difficulty about this, and indeed, it always pays to grow the green crops with mineral manures in order to get as large a bulk of green stuff as possible. Further, although the green crop only returns to the soil those minerals it took from it, a deep-rooted green manure crop, by opening up the subsoil, will not only bring up from the subsoil mineral substances which on its decomposition will be added to the surface soil, but also, the ensuing main crop will itself have a better chance of penetrating into the subsoil with its roots, and tapping the mineral resources there. There is also some evidence that a green manure used in conjunction with raw mineral phosphate renders the phosphoric acid of the latter more readily available to the succeeding crop.

(2) *Effect on the Supply of Nitrogen.*—Farmyard manure similarly adds to the soil large quantities of nitrogen. Much of this nitrogen has been purchased, either in the form of cake, or as manures used for the growth of roots or forage crops. The nitrogen in green manures, on the other hand, may be wholly, or largely a clear gain. Thus a leguminous crop collects from the atmosphere large amounts of nitrogen, which are added to the soil, when the crop is turned in. An average crop of vetches may easily add to the soil as much nitrogen as 10 tons of stable manure to the acre. Even a non-leguminous crop, though incapable of fixing atmospheric nitrogen, saves nitrogen for use by the subsequent main crop, by absorbing from the soil nitrates which would otherwise be lost in the drainage water. Green manures therefore may be regarded as comparing not unfavourably with farmyard manure as a means of adding nitrogen to the soil. The relative advantages of green manures and of fallowing on stiff soils are not definitely known. Fallowing is known to have a very beneficial effect on the biological processes of nitrification and nitrogen fixation, both of which are depressed by a growing crop, but on the other hand, the accumulated nitrate of a bare fallow may be lost by leaching in the autumn. Probably the best plan on soils which are known to benefit by a bare summer fallow is that already

mentioned as used in Essex, namely, to fallow during the dry summer months, and sow a green manure in early autumn to save the accumulated nitrates from leaching.

It is not, however, certain that the nitrogen added to soil by green manures is always as readily available to the following crop as that of farmyard manure. This is a point upon which further investigation is needed; the results of the Woburn experiment already quoted illustrate this aspect. Although the amount of nitrogen added to the soil by vetches was found to be markedly superior to that added by mustard, and although analysis of the soil showed that after vetches it was indeed richer in nitrogen than after mustard, yet the wheat after mustard was always a bigger crop than after vetches. Evidently there is some factor operating in the light land at Woburn to limit the availability of the nitrogen buried with the green crop, a factor which is apparently not operative in Rothamsted soil.

Although the nitrogen question is one which undoubtedly bulks large in the value of farmyard manure, and of green manures, it is not the indispensable factor in either. There is no reason to suppose that the requirements of a crop for nitrogen, as for minerals, cannot be adequately met by an enlightened use of artificials. As stated before, it is as a source of organic matter—" humus "—that farmyard manure must be chiefly prized, and it is similarly as a source of humus and by their effects on the physical properties of the soil that green manures must stand or fall.

(3) *Effect on the Supply of Moisture and on the Physical Properties of the Soil.*—We do not know definitely whether, bulk for bulk of dry matter, green manures are as efficient as farmyard manures as sources of humus, nor whether the humus produced from both is of the same character. These are questions which can only be answered after much more work has been done on the general question of humus formation and the nature and properties of humus, and in the meantime we can only assume that humus can be equally well derived from either, and that once formed it will have the same effects in both cases in improving the physical condition of the soil. It is evident then that the difference between farmyard and green manures will be due to the difference in their mode of preparation and application. The essential difference is of course that the farmyard manure is made off the land, and is usually applied only when decomposition is well in hand, whereas the green

manure is actually grown on the land to which it is to be applied, and is so applied in an undecomposed state. During the growth of the green crop important effects are exerted on the moisture content of the soil; on the one hand the transpiration of water by the growing crop dries out the soil, and light showers may not reach its surface; on the other hand, the surface of the soil is screened from the direct action of frost, the beating of rain, and the sun's rays. Whether these actions are beneficial or the reverse, depends, among other things, on the type of soil and the time of year.

The drying effect of transpiration will be of little consequence in the cooler part of the year or on a soil well supplied with moisture, but may be decidedly harmful on a light soil or in a very dry season. The screening of the soil from frost and the beating down of the rain may do no harm, or even be positively beneficial, on a light soil, while a heavy soil may suffer by being screened from frost, though it also probably benefits by being saved from the beating down of heavy rain. Further, the incorporation in the surface soil of undecayed plant material mechanically opens up the soil, and at the same time the capillary channels connecting the subsoil water with the surface are broken. These also are effects which may be beneficial or the reverse according to circumstances. A stiff cold wet soil benefits greatly by the improved drainage caused by this opening up, especially in the wet months of the year, but a light sandy soil which is already too open may be harmed unless the buried crop rots sufficiently quickly to lose its fibrous structure before dry hot weather comes round.

Again, even after the buried crop has thoroughly rotted, the effects of its previous growth may persist and influence the growth of the succeeding crop, either as a result of the drying out of the soil previously mentioned, or in the case of a deep-rooted green crop, by opening up the subsoil and enabling the ensuing crop to draw on supplies of subsoil water which it would not otherwise obtain. A striking illustration of this effect of a deep-rooted green manure crop is reported by Schultz, to whose pioneer work at Lupitz, in Saxony, so much of our knowledge of the principles of green manuring is due. Schultz grew potatoes on plots which had previously been green manured with lupins, and on adjacent plots which had received a dressing of farmyard manure of equal nitrogen content. The crops of potatoes were weighed and the depth to

which their roots penetrated was also determined. The results obtained were:—

Depth of rooting and yields of Potatoes after green manuring with lupins. Schultz—Lupitz. (Light sandy soil).

	After lupins.	*After farmyard manure.*
Depth of penetration of roots	47 in.	15-17 in.
Yield of tubers per acre	9 tons	6 tons

In a similar experiment with rye the results were:—

	Rye after lupins.	*Rye after potatoes and heavy dressing of artificials.*	*Rye on poor arable land.*
Height above ground...	47-66 in.	27-37 in.	20-35 in.
Depth of roots... ...	45 in.	20-24 in.	16 in.
Yield of grain per acre	27 bush.	12 bush.	$9\frac{3}{4}$ bush.

Space does not permit of a more detailed discussion of the mode of action of green manures, but it is hoped that the above remarks will serve to illustrate not only some of the reasons why under suitable conditions green manuring may have such beneficial results as it is known to have but also, how the attainment of success with green manures depends on a careful consideration of the actual conditions of soil, climate, etc., in the locality concerned. We thus come finally to the consideration of those practical questions on which ultimately the success of any system of manuring depends. We have seen that it is possible to obtain considerable crop increases by green manuring, and indeed that in certain districts in this country the system is used with success, and we have examined the factors which are operative in determining the action of green manures. What we now have to consider is how existing knowledge can best be applied in practice. It is not surprising that different soils, and districts with different climates, respond differently to similar methods of green manuring, and the knowledge at our disposal at present does not enable us to do more than suggest what are likely to be satisfactory systems to suit specified conditions. Many more careful experiments are needed before one can say with any degree of certainty what is the best method under given circumstances.

The Practical Problems of Green Manuring.—The practical problems fall into two parts: green manuring may be required either to maintain the fertility of land already yielding profitable crops; or to build up the fertility of poor waste land or of land which is badly run down and in danger of being no longer profitable to farm. In the first case, that of *maintaining* the fertility of the soil, it is obvious that the system adopted must interfere

as little as possible with the normal cropping. This rules out the possibility of giving the whole, or a large part of the growing season to a green manure crop, and it becomes necessary to take advantage of the intervals in the normal rotation. Now in ordinary farming on a standard four-course rotation, the only intervals usually available will be: (a) From the wheat harvest until the roots are sown the following spring, and similarly after oats or barley when seeds have not been sown with them in the spring, (b) From the time the roots are lifted until the spring corn is sown. As regards (b) mangolds or swedes and main crop potatoes are lifted too late for a catch crop to be put in, so that it is only when these crops have failed or after early potatoes or white turnips that this interval can be utilised.

Where a less rigid rotation is followed, as in market gardening districts, and even in ordinary farming now that the tractor has made possible much greater elasticity in rotations, many more favourable opportunities of catch cropping with green manures present themselves.

Suitable Crops.—It is thus clear that catch crops must be used which are able either to make rapid growth in the late summer and in autumn, or which can withstand the winter. The best crop to use depends very much on the district, but the widespread use of mustard is due to the very rapid growth it makes even on poor soils, so that if sown on the stubble in August, or even early September, it will give a good stand for turning in before winter corn or when the heavy frosts come on in November or December. Other crops which are to be recommended in districts where they are known to do well, are rye, oats, Italian rye grass, buckwheat (which does well on poor light soils), rape (giant or ordinary), and thousand-headed kale; all of these in a good season may give a good bulk of green stuff by the end of the autumn. In the case where the crop can be grown on through the winter for turning under in January or February before spring corn, or even later, before roots, other crops to be considered are vetches, crimson clover, red clover, winter beans, late swedes or turnips, and winter oats, rye or barley.

It is generally the case that a leguminous crop is to be preferred to a non-leguminous one, by virtue of its power of gathering nitrogen, but the Woburn results show that this is not always true, and in any case, since it is bulk of organic matter, rather than nitrogen which is primarily to be aimed at, the crop should be chosen which will give the largest growth in the time available and then, other things being equal, preference should be given

to a deep-rooted, nitrogen-gathering crop. The system of green manuring already mentioned as finding application in the Biggleswade district, and elsewhere, in which the green crop is sown with the spring corn, and turned under in the autumn or early in the following year, merits a more extended trial, and has the advantage that less rapidly growing legumes such as serradella, sainfoin, lucerne, and white, alsike, hop or Bokhara clover can be used. There is much scope for the trial of new crops not previously grown to any extent in this country. Among such may be mentioned an annual sweet white clover, *Melilotus alba*, var. *annua*, which has lately come into prominence as a fodder and green manure crop in the United States. Some seed of this crop has recently been obtained at Rothamsted, and is to be tried during the coming season. Soy beans also are used as green manure in America and could profitably be tried in this country. One of the chief difficulties liable to be met with in green manuring is that the catch crop has often to be sown in very dry soil, with somewhat uncertain prospects of good germination. Here again, there is much scope for the introduction of new varieties specially adapted to give good germination and growth under dry conditions.

When to Plough in.—A point needing careful consideration is whether green manures preceding a spring-sown crop should be turned under at the beginning or the end of the winter. This depends to a large extent on the district. On a light soil, where decomposition is rapid and leaching considerable, it is probably best to leave the crop above ground as long as possible. Such a soil does not suffer appreciably by being protected from the action of frost, while if the crop is turned under at the beginning of the winter, decomposition may have proceeded so far by the spring that a large part of the nitrogen will have been lost in the drainage water. The results of the Wisley experiments quoted above illustrate this point. On a stiff soil, however, rotting is slower, and leaching much less, while the mechanical action of the unrotted plant material in facilitating drainage during the wet season will be beneficial, so that on such soils it may be better to turn the crop under earlier, say in early December, so that the heavy soil may be exposed to the beneficial action of the hard frosts.

Another practical point to be borne in mind is the minimum time which should elapse between the turning under of the green crop and the sowing of the succeeding main crop. In some cases failure of the main crop has been found to occur if the in-

terval has been too short. This may be due to some check on germination by the primary products of decomposition of the green manure or to the action of fungi, but this harmful action disappears in a short time, and it may be taken that an interval of about one month is sufficient.

Green Manuring for Land Reclamation.—In dealing with the second part of the problem, that of building up the fertility of waste or exhausted land, greater opportunity for green manuring is available. On such land, which with ordinary farming brings in little or no profit, the green manure can be grown as part of a special rotation in which the whole of a growing season is given up to the green crop, or a series of green crops. For poor, light sandy soils, in cases where the application of lime is too costly, blue lupins are a very suitable crop, and the results obtained in Germany by Schultz, and more recently in Suffolk and Notts., as already quoted, show with what success such a method may be used. Where lime can be applied, many more crops are available; field peas, horse beans, and the like merit consideration, and choice can also be made of such of those crops mentioned in the preceding paragraphs, which are suitable to the soil concerned.

Manuring of the Green Crops.—In order to get the best possible growth of green crops, a sufficient dressing of phosphate should always be given, together with potash if there is any indication of its being needed. A moderate dressing of nitrate of soda or sulphate of ammonia will also often be beneficial, in giving the crops a good start, especially for crops sown on the stubble, where nitrates will be at a low ebb.

Method of Turning in the Green Crop.—With regard to the actual turning under of the green crop, if the latter is very dense, it should be gone over in front of the plough with a disk-harrow or roller, or an extra horse should be put on in front of the team to help trample down the crop. It may also be necessary to fix a heavy chain on the plough and to use a disk coulter. As to depth of burial, it is generally found that shallow burial, 5 in. to 6 in. is as good as, or better than deep burial. There is also some evidence that the rotting of the buried crop is expedited if a very light dressing of stable manure is ploughed in with the green crop.

What Crops benefit most by Green Manuring.—There is some evidence that hoed crops such as potatoes, sugar beet, mangolds, and turnips, benefit more than others by green manuring,

and since the interval between wheat and roots in the ordinary four-course rotation is the one in which green manuring with catch crops can be most easily fitted, more attention should be directed to the use of green manure for these crops. Green manures for winter wheat appear also to be undoubtedly of great benefit, though it is apparently for wheat especially that there appears to be some uncertainty as to the relative merits of leguminous and non-leguminous crops.

The Economic Value of Green Manures.—In conclusion, it must be pointed out that we are not in possession of precise data concerning the economic value of green manures. The fact that they find extended application in many places abroad and in special districts of this country is good evidence that their use in many circumstances is economically sound, but in considering them as an alternative to animal manures we are brought up against the vexed question of whether the keeping of animals merely as manure-makers is an economic proposition. There is no doubt that on light lands, the standard system of feeding green crops to sheep folded on the land will hold its own against green manuring in many districts, but after all, there is a limit to the number of sheep any farmer can keep, and many specialist growers would prefer to do without them; moreover, some of the poor light lands like those of Suffolk are not suitable to sheep.

On heavy lands it is often not practicable to fold sheep on the arable fields, and on such lands, if green manuring is not adopted, all the animal manure which is required beyond that given by the stock normally kept for fatting or dairy purposes, must be provided by extra cattle kept primarily for the manure they provide, or must be bought in. By going in for green manures, the farmer could wholly or partly dispense with these extra cattle, could reduce his area under roots and forage crops, and use a greater proportion of his land every year for growing marketable crops. Although in some circumstances a green manure crop itself may encroach somewhat on the time the land is available for growing a marketable crop, it must be remembered that this may be more than made up for by the increased crops obtained, and by the fact that in growing a green manure on the land to which it is to be applied, all charges for carting and spreading dung are avoided. With prevailing prices of feeding stuffs and of labour the cost of producing and applying animal manure to the land is undoubtedly very many times that of the same amount of organic matter and nitrogen applied as green manure.

COUNCIL OF AGRICULTURE FOR ENGLAND.

THE Eighth Meeting of the Council of Agriculture for England was held on 18th May, 1922, at the Middlesex Guildhall, Westminster. The chair was taken by Sir Douglas Newton, M.P., K.B.E., who was elected Chairman for the year 1922. The Minister of Agriculture, Sir Arthur Griffith-Boscawen, M.P., was present throughout the proceedings.

Statement by the Minister.—At the opening of the meeting, the Minister made a statement on the agricultural situation, covering the main items of importance since the meeting of the Council in December last. He referred first to the depression in agricultural prices which had come upon the industry with appalling suddenness. Farmers had, in consequence, been in great difficulties, and landlords had been unable to come to their assistance. Since January last, however, there had been signs of improvement. The help which had been given when things were really at their worst by the payments in lieu of guaranteed prices had certainly come at an opportune time. Of the 187,000 total claims, 150,000, or 95 per cent. of the claims made up to 18th July, 1921, were paid on 1st January last. Over 5,000 more were paid in the first week of January, and nearly all the remaining claims had been paid by the end of January.

With regard to the question of wages, the farmer could not possibly continue to pay the wages which he was paying a year ago in the face of a 50 per cent. decline in prices. The necessary reductions had been carried out through the Agricultural Conciliation Committees, generally, he was glad to say, in a spirit of goodwill and with very few disputes. There were 61 Conciliation Committees in England and Wales in place of 39 old District Wages Committees; 54 of these had made agreements, of which 44 were now current. Most of the agreements were for long periods.

The Minister then referred to the foot-and-mouth disease outbreak, which had been the worst in the country since the year 1883. He expected that it would cost not less than £1,000,000 to stamp it out, although, having regard to the value of the live stock in the country and the nature of the disease, the money will have been well spent if the disease is entirely eradicated. It had been stated that a large proportion of the live stock of the country had been slaughtered. As a matter of fact, there had been slaughtered, as diseased or in contact, 22,000 cattle, or

one-third of 1 per cent. of the total, 20,000 sheep, or one-tenth of 1 per cent. of the total, and 9,000 pigs, or one-third of 1 per cent. of the total.

Turning then to the recommendations of the Geddes Committee, which Committee, he said, had performed a very valuable service to the country generally, reductions of the Ministry's expenditure had been proposed which he had been unable to accept Before the Geddes Report, the Ministry had itself made a reduction amounting to about 36 per cent. of its expenditure. The Committee, nevertheless, proposed further reductions and suggested that the live stock scheme, including the bull and boar scheme and the milk recording scheme, should be stopped. He had, however, been able to convince the Cabinet that they should be retained. As regards the grants for agricultural education and research, the Committee had suggested that, in view of the extra £1,000,000 which had been acquired for Agriculture under the Corn Production Act (Repeal) Act, there ought to be a big cut in the amount which we had been spending upon that subject before the grant had been obtained. To carry out such a proposition, however, appeared to the Minister to involve a most distinct breach of faith with the agricultural community. He, therefore, with the aid of the Secretary for Scotland, whose Department was affected in the same way, had been able to make his case good before the Cabinet, and the original grants for agricultural education and research were accordingly retained. The share for England and Wales (£850,000), as to the allocation of which the Agricultural Advisory Committee had been consulted, would be spent, as far as possible, on large and important services, such as the proposed new institute for Veterinary Research. The Minister here outlined the main items which the proposed allocation covered. He went on to say that during the last few months a good deal of work had been done for the relief of unemployment by means of land drainage work. A grant of £650,000 had been obtained for land drainage, of which about £400,000 had been spent on 368 schemes which had been sanctioned. Ditches and water-courses had been cleaned out and land rendered cultivable which formerly had been water-logged. To-day, about 8,000 men were being employed and valuable work was being accomplished.

Within the period under review, the difficulty as to milk prices had been settled, with the result that farmers got 2½d. per gallon more for their milk for the next six months than they would have done under agreements many of which had already been signed.

The duties on home-grown sugar had also been remitted, and he hoped that this would lead to the firm establishment of the sugar beet industry in the country. Then there had been a very valuable concession to farmers in regard to income tax. On the question of the burdens on land, he agreed that rates were too high, and thought that land was unfairly assessed; and he was considering what means could best be recommended for dealing with the matter. He was glad to say that there were no very important agricultural bills now before Parliament. Two measures, however, he would mention: (1) a Consolidation Bill of the various Agricultural Holdings Acts, and (2) the Allotments Bill. Both were admirable measures of their kind. He would conclude upon a note of optimism. We had been going through dark days, but he hoped and believed that there was a brighter future in store for the industry.

Mr. Donaldson proposed, and Lord Bledisloe seconded, a vote of thanks to the Minister for his address.

Importation of Store Cattle.—The first of the motions down on the Agenda, moved by the Earl of Northbrook and seconded by Mr. James Hamilton (Lancs) was as follows:—

> "That the Council of Agriculture for England re-affirms the resolutions which were passed at the Meetings held on 4th March and 22nd November, 1921, to the effect that the existing restrictions on the importation of store cattle should be maintained."

Lord Northbrook said that he was most anxious that Canada should have fair play in this matter, and that any slur which the Canadian farmers might feel has been placed upon them should be removed; and he was further anxious, like every other Englishman, that any definite promise given by the British Government should be honourably fulfilled. But he thought that the Council should also claim fair play for British agriculture and the faithful redemption of the promises which had been made on so many occasions to the farmers of this country. In view of the position in which the matter now stood, he hoped that the Minister would be able to assure the Council that the Government were not weakening on the question.

Mr. James Hamilton said he could not make it too clear that there was no question raised as to the health and soundness of Canadian cattle. The "embargo" was applied to all countries. The Act of 1896 keeps all store cattle from over-seas out of the country. The present agitation had been raised with a view to reducing the cost of living. The argument of the agitation was that the restrictions on the importation of stores should be

removed so that they would become very plentiful and thus reduce the price of beef. The assumption was that the price of stores was a considerable factor in determining the price of beef. Sir Daniel Hall had pointed out in his evidence before the Royal Commission that the price of home-fed beef was determined by the price of chilled beef. The experience of the last two years had been such as to confirm this statement.

Mr. E. G. Owles (Norfolk) said that Norfolk as a whole was strongly in favour of lifting the embargo so far as Canadian cattle were concerned. At a meeting held in Norwich in March last, when at least 1,000 farmers were present, four only had voted in favour of the embargo. There were only two ways in which a larger and cheaper supply of home-bred fat beef could be had, and these were (1) by admitting Canadian store cattle, or (2) by requiring that no calf suitable for rearing should be slaughtered under six months old. The latter method had the disadvantage of tying up cows with their calves for a time instead of producing milk for human consumption.

Mr. J. R. Spraggon (Durham) asked how many of the 1,000 people at the Norwich meeting were farmers. A similar meeting in Northumberland had been reported to be a farmers' meeting and was not.

Mr. W. R. Smith, M.P., said that the question at the moment was Canadian cattle, and it was important that the issue should not be clouded by reference to the cattle from other countries. He had been present at the meeting in Norwich to which Mr. Owles referred and could unhesitatingly say that the meeting was one of *bona fide* farmers. Before altering his view, he would want more sufficient reasons why the embargo should not be removed, thus giving the farmer a better chance in his business.

In opposing the motion, *Mrs. Middleton* stated that at the meeting in Northumberland to which Mr. Spraggon had referred, which was held in March last and presided over by the Duke of Northumberland, there were between 450 and 500 people present and only two voted in favour of retaining the embargo. The Mother Country should not take as her motto "Safety first." It should be looking to the safety of her children as well as herself. Production should be founded on the principle of competition, co-operation and common sense.

Lord Bledisloe asked whether the interests of Canadian farmers were to be placed before the interests of the majority of English and Welsh farmers, and whether, if the embargo were to be raised, Canada was to remain the exception to the rest of the countries of the world. He foresaw very serious difficulties,

diplomatic and otherwise, if any exception were commenced. Nine-tenths of agriculturists were opposed to the removal of the embargo which for a quarter of a century had assisted the cattle-breeding industry to an amazing extent and offered the country the greatest protection against starvation in time of war. Was the House of Commons, without any appeal to the country on the subject, going to decide the matter and remove the embargo, thus laying the country open to the dangers which the Council knew would be awaiting it if such a thing happened?

The Minister outlined the position of the Government in the matter, and said that he was quite content to abide by the decision of the Council. He pointed out that there was no such thing as a Canadian embargo, as such. The policy of taking no store cattle from anywhere overseas had been followed for the last twenty-six years and had been extraordinarily successful. Till this year we had had practically no disease and our flocks and herds had steadily grown. Parliament would have no right to alter the deliberate policy, so long carried on by Governments, Liberal and Conservative, with regard to live stock, which was the most important side of the agricultural industry, without real and sufficient reason. He then dealt one by one with the reasons that had been brought forward, and said that he saw no argument which would lead him to depart from the attitude taken up by his predecessors, and that he would speak and vote and do his utmost to defeat the resolution in favour of removing the embargo when it came before the House of Commons.

Mr. George Edwards, M.P., then spoke in favour of the removal of the embargo and said he did so in the interests of agriculture.

Sir Merrik Burrell referred to Lord Northcliffe's recent speech and mentioned a statement which had appeared in the *Times* of 15th May, being a quotation from the *Montreal Star*. He was more prepared to place reliance upon that than upon statements of certain newspaper leaders. The value of the agricultural industry could not be measured by mere voting power. As the country became more and more industrial, so the value of the agricultural industry increased. All questions of agriculture should be outside party politics.

Mr. H. German (Leics.), speaking as Vice-President of the National Farmers' Union, representing 54 out of 56 branches and 600 local branches, said that the Union had a mandate from them to oppose the lifting of the embargo. He made the offer

to Mr. Smith and Mr. Edwards to come as his guests to one part of England which would be turned into desolation if Canadian cattle were admitted. He was also prepared to go down to Norwich and prove to the people of Norfolk that it was in the national interest that the embargo should be kept on.

The motion was then put to the Council and passed by a vote of 60 against 11.

Milk and Dairies Act, 1915.—The Right Hon. Lord Strachie moved :—

> "That in the opinion of this Council it is undesirable to amend or repeal the Milk and Dairies Act, 1915, before it is put into operation."

In moving this resolution, *Lord Strachie* said he thought the safeguards in the Act had been completely misunderstood. The National Farmers' Union were proposing alternative legislation dealing with several complicated points and it put forward no suggestions for similar safeguards. The Act of 1915 was a compromise and, like other compromises of the kind, would probably work satisfactorily. It was laid down in the Act that no Order should be issued by the Minister of Health except with the concurrence of the Minister of Agriculture, and also that Orders could not come into force until they had been laid on the tables of both Houses of Parliament for forty days, during which time objection could be taken to them. The Central Chamber of Agriculture, the Bath and West Council and also the Central Landowners' Association had approved the course proposed in the motion.

Mr. H. C. Gardner (Worcs.) seconded the motion and *Lord Northbrook* and *Lord Bledisloe* spoke in favour of it. *Mr. J. Donaldson* (Oxford) opposed on the ground that the proposals which were now in contemplation at the Ministry of Health were more in accordance with our present requirements. *Mr. George Dallas* considered that the interests of the community were for a pure milk supply, and that the Council ought not to attempt in any way to interfere with regulations which would help to produce such a supply. *Mr. German* agreed with Mr. Dallas. He thought that it was also necessary to provide a sufficient quantity of milk so that no child should be in want of it. The British farmer is prepared to put pure milk on the market, but the milk as it reaches the consumer is not as produced by the farmer. He thought it was the wrong time to bring up regulations which involve supervision of a number of points, such as cleaning udders, washing hands, scalding buckets, etc., and he therefore opposed the resolution.

Sir Daniel Hall, who was appointed to speak on behalf of the Ministry in the matter, said that the estimates of the cost of the Act of 1915 were such as to put the possibility of working it at the present time out of the question. The Ministry of Health would need £700,000 per annum for the Act, and the Tuberculosis Order, which the Ministry were to operate side by side with the Act, would cost another £75,000 per annum. In these circumstances, another Bill had been prepared by the Ministry of Health, who had consulted the Ministry of Agriculture upon it, and it was the Minister's intention within the course of a week to ask the advice of the Agricultural Advisory Committee on the new proposals.

Mr. Christopher Turnor spoke as to the food value of milk, and the desirability of increasing its consumption and in particular of purifying the supply. *Sir Merrik Burrell* then moved the adjournment of the debate until the provisions of the new Bill had become available. *Sir Arthur Hazlerigg* seconded, and after some further discussion, the motion, to which Lord Strachie was not averse, providing the Minister of Agriculture and Parliament retained their powers of vetoing Orders, was put to the meeting and carried. *The Minister* assured the Council that due weight should be given to the point raised by Lord Strachie.

Wart Disease of Potatoes. *Mr. A. G. Daniels* (Herts) moved :—

"That this Council learns with the gravest possible concern that modifications of the Ministry's scheme for the control of Wart Disease of potatoes are proposed ; and it is of opinion that any policy which reduces the activities of the Ministry in controlling the disease will have a detrimental effect and will militate against real economy and food production ; and it further urges that the policy of 1921 be pursued and embodied in an Order of the Ministry."

He understood that proposals to amend the policy of 1921 had been put forward in order to save £5,000 per annum on administrative expenses. The policy of 1921 had been carefully considered by the Potato Advisory Committee and had been approved by the Agricultural Advisory Committee. The Ministry had been doing admirable work, and the 1921 policy would give them better opportunities to control the disease. The new proposal was a retrograde step. *Mr. R. R. Robbins* seconded the motion. He reminded the Council that in 1919 there were 3,000 outbreaks of Wart Disease and that in 1921 that number had fallen to 300, so that it might not be a real economy to save £5,000 per annum and scrap a policy built on lines which had proved successful.

Sir Daniel Hall suggested that the grounds upon which the latest proposals were made were being rather misrepresented. The change was not one that was proposed merely for the sake of saving £5,000 per annum : there was a definite change of policy suggested. The original measures largely depended upon the fact that in certain areas in the country only immune potatoes could be grown. It was found that such a requirement inflicted an intolerable hardship upon certain of those localities, and the Ministry decided to concentrate their efforts upon ensuring that a supply of guaranteed pure seed should be secured for growers, whether the variety required was a susceptible or an immune one. That change of policy was common both to the 1921 policy and to the new 1922 policy. The difference was that the last-named policy went still further in the direction of safeguarding the seed and let the other part of the administration go, thus effecting a desired economy The latest proposals, however, had not been accepted by the Potato Advisory Committee or the Agricultural Advisory Committee. The Ministry were therefore considering a fresh revision which would be submitted in due course to the two Committees named.

Mr. Gardner, speaking as a member of the Potato Advisory Committee, said that he was not at all sure that the 1921 Order, which had never been put into force, would, if operated, give the same good results as were achieved under the old Order.

The motion was then put to the meeting and passed.

Allotments Bill.—*Mr. J. Forbes* moved :—

"That this Council welcomes the introduction of a Bill to amend the Allotment Laws and gives its support to any measures which are designed to make land more easily available for allotments and to improve the security of tenure of occupiers of allotments."

He said that there were to-day as many as 1,330,000 allotment holders in England and Wales, and the great bulk of them were in industrial and urban areas. The Bill was the result of the recommendations of a Departmental Committee and he urged the Council to give it all possible support.

Mr. George Nicholls (Soke of Peterborough) seconded the motion, and said that the way in which allotment holders had been holding on to their land since the departure of war conditions had been a great surprise to many who had been in touch with the work over a long series of years. *Lord Bledisloe* also spoke in favour of the motion, which was then put to the meeting and carried.

Destruction of Rabbits.—*Mr. Donaldson* moved :—

"That this Council regrets the delay of the Minister of Agriculture in introducing a Bill to provide for the destruction of rabbits, as requested by this Council, and is further of the opinion that, as this body may be taken to be entitled to speak for County Agricultural Committees, which would in fact administer the Act, any objection on the score of administrative difficulties cannot be regarded as warranting the non-introduction of the measure."

He said that the rabbit pest was becoming a great nuisance to agriculture, and that the legislation asked for should be pressed on by the Ministry notwithstanding objection from the County Councils Association. That Association did not represent agriculture, and therefore should not prevail.

Lord Bledisloe seconded the resolution, pointing out that there was no opposition whatever from landlords in regard to this question. *Mr. Christopher Turnor* also supported the resolution.

The Minister said that it was not fair to say that the Bill had been turned down by the County Councils Association. The need for economy at the present time is imperative, and he desired to have the concurrence of the Association as the expense would have to be borne by the County Councils. The Association had a meeting on 24th May, and he hoped, after their reply, to be in a position to push the matter forward. *Lord Strachie* said on behalf of the County Councils Association that they were not hostile to the proposal but only anxious as to the cost of the measure. The motion was then put to the meeting and carried.

Reports.—The Council received the Report of the Sub-Committee to consider the question of providing further credit facilities for farmers, the Half-yearly Report (No. 3) of the proceedings of the Agricultural Advisory Committee (printed at p. 257), and the Memorandum which the Ministry had prepared containing their proposals to make the Annual Agricultural Returns compulsory. In moving the reception of the first-named Report, *Mr. G. G. Rea* (Northumberland) said that the report was not by any means so far-reaching as the Sub-Committee would have liked to make it. They were guided by two important principles, the first to get something done quickly, and the second to avoid heavy expenditure. The recommendations in the report followed those principles.

AGRICULTURAL ADVISORY COMMITTEE FOR ENGLAND AND WALES.

THE following is the half-yearly report (No. 3) of the Agricultural Advisory Committee for England and Wales to the Councils of Agriculture for England and Wales, on the Proceedings of the Committee :—

Since the date of the last report,* the Agricultural Advisory Committee has met seven times, two of the meetings being special meetings to consider the position in regard to Foot-and-Mouth Disease. The following subjects were considered, with the results stated :—

(1) **Restrictions on Exportation of Artificial Fertilisers.**—In the last Report it was stated that the question of the final removal of these restrictions had been brought before the Committee, and consideration deferred by it for a month. It had in the first place been explained that an Order in Council under the Fertilisers (Temporary Control of Export) Act, 1920, prohibited the export of sulphate of ammonia, superphospate, basic slag, and compound manures containing any of these, except by licence of the Board of Trade. An open general licence had already been issued authorising export of sulphate of ammonia.

The restrictions had been imposed at a time when the stocks of fertilisers in the country were low. This position had altered; large stocks had accumulated, and manufacturers were making an insistent demand to be allowed to export. The only fertiliser that was, as a matter of fact, really being restricted in export was high grade basic slag; and now about 600 tons were required to be exported. It was represented that this could be allowed without injury to agriculture. If there was likely to be a shortage of slag in this country it was considered that the restrictions could be reimposed. The Committee agreed to the Ministry advising the Board of Trade to allow exportation as suggested, the position in regard to the supply and home requirements of artificial fertilisers to be kept under observation from week to week.

(2) **Importation of Goats for Breeding Purposes.**—The British Goat Society had asked permission to import pedigree goats for the purpose of improving the breed of animals in this country. No importation had been made since 1903, and it was suggested that the time had arrived when another importation under suitable conditions of quarantine might be effected. It was agreed that the request might be acceded to, the British Goat Society purchasing the animals to be imported and arranging the importation as their own affair, the Ministry prescribing the necessary quarantine and conditions of importation.

(3) **Proposed Rabbit Pest Bill.**—The following Resolution of the Council of Agriculture for England was considered :—

> "That the Council recommends the Ministry to promote legislation on the lines of Section 10 of the Corn Production Act, 1917, recently repealed, with the object of enabling Agricultural Committees to deal with the

* This *Journal*, January, 1922, p. 942.

rabbit pest in cases where damage to crops and plantations is sustained by the attacks of vermin from adjoining occupations."

The Committee recommended that a Bill should be drafted on the lines suggested. This was done and referred for observations to the County Councils Association. The matter was again considered by the Committee after these observations had been received and it was decided to recommend that the Bill should be proceeded with, notwithstanding that the County Councils Association were not satisfied that there was any necessity for legislation in the form proposed.

(4) **Scheme for the Voluntary Registration of Bulls.**—This Scheme, which had been referred back to the Committee by the Council of Agriculture for England for further consideration, was put by to come up again when the voluntary scheme of registration now proceeding in Buckinghamshire had developed.

(5) **Importation of Store Cattle.**—At its meeting on the 14th December, 1921, the Committee passed a resolution in the same terms as that which had been passed at the meeting of the Council of Agriculture for England on the 22nd November, 1921.

(6) **Provision of Telephones at Railway Stations Goods Yards.**—It was reported that the Controller of Horticulture had brought the question of the provision of telephones at five railway goods stations where it was needed to the notice of the Ministry of Transport and the Railway Company concerned. As a result, a promise had been made by the Company that telephones would be installed at three of the five stations in question. Exception was taken in the Committee to the fact that this action did not meet the general question of the lack of telephone facilities. The following Resolution was accordingly passed:—

> "That in the opinion of this Committee all railway goods stations at which farm produce and supplies are dispatched or received should be connected with the public telephone forthwith."

Further representations were made to the Ministry of Transport, and the Ministry of Agriculture were informed that Railway Companies were not prepared to instal telephones at stations where they do not consider that the traffic warrants such a course, or would make it a remunerative proposition from the Railways' point of view. The Ministry of Transport, moreover, felt that the general question of the provision of telephone facilities at railway goods stations was not a matter that should be taken up by the Interdepartmental Committee on the Transport of Horticultural Produce, and it was that Ministry's view that the best course was to take up each individual case as it arose with the Railway Company concerned. The Agricultural Advisory Committee agreed that in the circumstances no general action appeared to be possible and that the only practicable policy was that suggested by the Ministry of Transport.

(7) **Railway Rates for Agricultural Produce.**—On considering this general question the Committee passed the following Resolution:—

> "That this Committee strongly urges on the Ministry the absolute necessity of making representations forthwith to the proper quarter as to the unduly high railway rates which exist on agricultural produce at the present time, as there is no doubt that they constitute a serious handicap to the agricultural industry."

A Memorandum was drawn up stating the legal position in regard to proceedings before the Rates Tribunal* and referring incidentally to the position of the Ministry in the matter. It appeared that under the new legislation the Ministry, as such, had no *locus standi* in any appeal which might be made, though it could as heretofore make representations to the Railway Clearing House or to individual Railway Companies in specific cases. As a result of further discussion in Committee, the Minister communicated with the Ministry of Transport on the question. That Department agreed that the Ministry could not appear before the Railway Rates Tribunal as a matter of right on behalf of agricultural representations. At the same time, the Minister promised that everything would be done by the Ministry to assist agriculturists in making their representations to the Tribunal.

(8) **Foot-and-Mouth Disease Outbreak.**—Soon after the discovery of the disease in the country, the Minister called a special meeting of the Committee and informed them of the main facts of the outbreak and of the measures taken to arrest it. The Committee agreed that the policy adopted appeared to be the right one in the circumstances. The Minister pointed out that there was no justification for any rise in the price of meat, such as was then taking place, because of the slaughter of the comparatively small number of animals involved in the protective measures. On the question of policy, the value of the flocks and herds might be estimated at somewhere near £312,000,000, and if a policy of isolation and treatment were adopted with the practical certainty of the spread of the disease throughout the country, a very serious loss to farmers and to the community would be incurred. Some special proposals were made for dealing with valuable pedigree stock by isolation rather than slaughter should they contract the disease, and points of detail arising out of the conduct of the general operations were discussed. The Minister arranged to call the Committee together again immediately in the event of the disease spreading widely and becoming epidemic.

A further special meeting was held on the 23rd February to consider the question of expenditure on Foot-and-Mouth Disease. It was reported that although the outlook in regard to stamping out the disease was not unpromising, expenditure was mounting, so that the question had to be considered whether an extension of the very restricted use of isolation might not be made. The following Resolution was adopted :—

> "That this Committee strongly urges the Minister to continue the present policy of slaughter for another two weeks, providing for isolation where this can reasonably be carried out."

Reports of the position in regard to the outbreak were made at each subsequent meeting of the Committee and advice requested upon several points of principle and practice arising in the course of the operations against the disease. There has been no occasion to depart from the general policy of slaughter, with isolation in a comparatively few cases.

(9) **The Allocation of the Grant of £850,000 for Agricultural Education and Research.**—As mentioned in the previous Report to the Council, a Sub-Committee of the Agricultural Advisory Committee had been appointed to go into the details of this matter with the Ministry and to report to the Committee. A statement embodying the main conclusions arrived at by this Sub-Committee was considered at the meeting of the Committee on the

* This *Journal*, April, 1922, p. 41.

8th March. It was reported that the Treasury had agreed to the expenditure of the sum in question, with interest, in the next five years, and that the existing grants in respect of agricultural education and research should be retained. It was understood that further funds for the annual maintenance of the work thus commenced or developed would be forthcoming after the five-year period. The Committee approved the proposals subject to certain conditions and assurances which were duly recorded.

(10) **Credit Facilities for Farmers.**—It will be remembered that a Sub-Committee was appointed at the request of the Council of Agriculture for England to consider this question. The original terms of reference which were stated in the last Report to the Council were extended by the Agricultural Advisory Committee in order to enable the Sub-Committee to consider the question of long term credit in cases where owners had recently purchased their farms. The Sub-Committee presented its Report to the Meeting on the 8th March last, and it was accepted. The Report was framed on the understanding that it would be possible for the Government to give effect to most of its recommendations without the need of waiting for legislation. The Agricultural Advisory Committee was informed, however, at the time of presentation of the Report, that this was ascertained by the Ministry not to be possible in the circumstances then existing, there being no funds available with the Development Commissioners for the purpose. At a later Meeting of the Committee it was stated that the matter had been laid before the Chancellor of the Exchequer and that he had been unable to do anything so far and hesitated to do so because of the difficulty of resisting claims of other industries which were at the present time also hard-hit financially. The Minister told the Committee that he thought the issue was one which should be explored by a Departmental Committee which might endeavour to suggest the most suitable line of action through co-operative credit associations.

(11) **Proposed New Modification of Wart Disease of Potatoes Policy.**—In the last report to the Councils of Agriculture it was noted that the Wart Disease Policy, which had obtained for some years, was to be revised. Owing to the fact that decreased funds were available for the Ministry's work, it was found necessary to suggest that the revised policy should be amended and the measures taken by the Ministry in the matter much simplified. The Potato Advisory Committee, however, sitting on the 2nd May, disagreed with this proposal and passed the following Resolution :—

> "That this Committee recommends the Ministry to put into force the suspended 1921 policy, subject to such amendments as the Ministry's experts may deem advisable as to the scheduled areas in Scotland, and strongly protests against the policy proposed to be substituted as quite inadequate to safeguard the clean areas in England and Wales, and as a policy which would ultimately be detrimental to the export trade in potatoes."

At the last meeting of the Agricultural Advisory Committee, which took place on the 3rd May, it was suggested, after some discussion, that consideration of the matter be postponed until the next meeting, when the Ministry will have had an opportunity of considering the Resolution of the Potato Advisory Committee.

(12) **Agricultural Improvement Regulations, 1922.**—It was reported to the Committee that Regulations, dated 9th March, 1922, had been

made varying the rates of interest to be paid under Section 3 (3) of the Agricultural Holdings Act, 1908, in respect of the execution of certain improvements by landlords, from 5 per cent. and 3 per cent. to 6½ per cent. and 4½ per cent. respectively.

(13) **Scheme for Scholarships, etc., for Sons and Daughters of Agricultural Workers.**—The Report of the Special Committee which had been appointed to draw up a scheme for "establishing scholarships and maintenance allowances for the sons and daughters of agricultural workers and others" under Section 3 of the Corn Production Acts (Repeal) Act, 1921, was communicated to the Committee. After discussion it was approved. The proposal of the Special Committee was to establish three classes of scholarships, one for the highest type at Oxford or Cambridge, or possibly other Universities, for three or four years; another for scholarships at Agricultural Colleges which would lead up to a diploma; and the third for scholarships at Farm Institutes or Colleges which carry on short courses. There were to be ten scholarships a year in the first class, ten in the second, and three hundred term-units in the third.

(14) **Proposed Amendment of Silver Leaf Order of 1919.**—It was suggested that the date, 1st April, by which the Order requires that dead and diseased wood should be cut out of fruit trees, be altered to the 15th September, and that the Ministry should strongly urge fruit-growers to carry out this work if possible during May and the first half of June. It was also urged that all reasonable protection should be taken by the application of Stockholm tar, grafting wax, or other suitable preparations to guard the cut surfaces of trees against reinfection by spores. These suggestions were made to the Ministry by the Horticultural Advisory Council at their meeting on 25th March, and were agreed to by the Agricultural Advisory Committee subject to the alteration of the date from 15th September to 15th October.

(15) **Encouragement of Co-operative or Travelling Dairy Schools.**—It was suggested that the Ministry's Scheme for supplying counties with facilities for starting co-operative or travelling dairy schools should be extended. The scheme was approved by the Committee, who agreed that it should be brought to the notice of County Councils.

(16) **Reports of Proceedings of the Various Advisory and Departmental Committees set up by the Ministry.**—Two reports were received by the Agricultural Advisory Committee outlining the work done by the other Committees of the Ministry. On the consideration of the last Report, the question was raised as to the possibility of broadcasting accurate daily weather reports by wireless. The matter was already being considered by a Sub-Committee of the Agricultural Research Council, but it was promised on behalf of the Ministry that it would be separately looked into.

(17) **Agricultural Returns to be made Compulsory.**—A proposal that these returns, which had been made compulsory as a temporary measure during certain of the War years, should now permanently be made compulsory on occupiers of land, was considered and approved by the Committee. It was agreed that the Ministry would be well advised to proceed with a Bill to effect this object.

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CULTIVATION OF THE HOP CROP.

V.—PICKING, DRYING AND PACKING OF HOPS.

PART II.

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Hop Kilns.—Hops are dried in buildings which are called hop-kilns, several of which may be grouped together around a central cooling and packing floor. The collection of these buildings is called a hop " oast." The kilns in this country are generally constructed with brick walls, although in the Western States of America, where lumber is cheap, they are commonly built of wood. The roofs may be covered with tiles or slate and ceiled inside with plaster to make them air-tight, or alternatively may be covered with felt which is tarred annually for the same purpose.

Fig. 1 represents diagrammatically an open fire kiln such as is most commonly used in this country; such kilns may be circular or square, the former is rather more economical to build, but the latter is more convenient for use. The most convenient size is probably 18 feet square or 20 feet in diameter, with walls 18 to 20 feet in height, so that the drying floor, which is fixed about 4 feet below the top of the wall, may be at least 12 feet above the top of the fires. The floor consists of wooden joists and battens upon which is stretched a horse-hair cloth, resistant to the effects of heat; upon this the hops are spread for drying.

The roof slopes upwards from the top of the walls to an opening 3 feet or so in diameter. Above this opening is fitted a cowl C, swinging freely upon well-oiled bearings, so that each change in the direction of the wind causes it to swing round and allow a free escape of the air through its opening. The height of the cowl from the hair should be as great as possible (16 ft. to 18 ft.).

The fireplace or places are generally raised about 18 in. above the ground floor and are built to one of the outside walls so that they can be stoked from outside the kiln.

Hot-Air or Stove Kilns.—In normal hop drying the products of the coal fires must pass through the hops; any smoke, which may be produced, thus causes a taint in the hops, consequently only the best anthracite coal is permissible and this is expensive.

To enable the substitution of cheaper forms of fuel—wood in the Western States of America and coke in this country—various patterns of stove kilns have been designed which have the com-

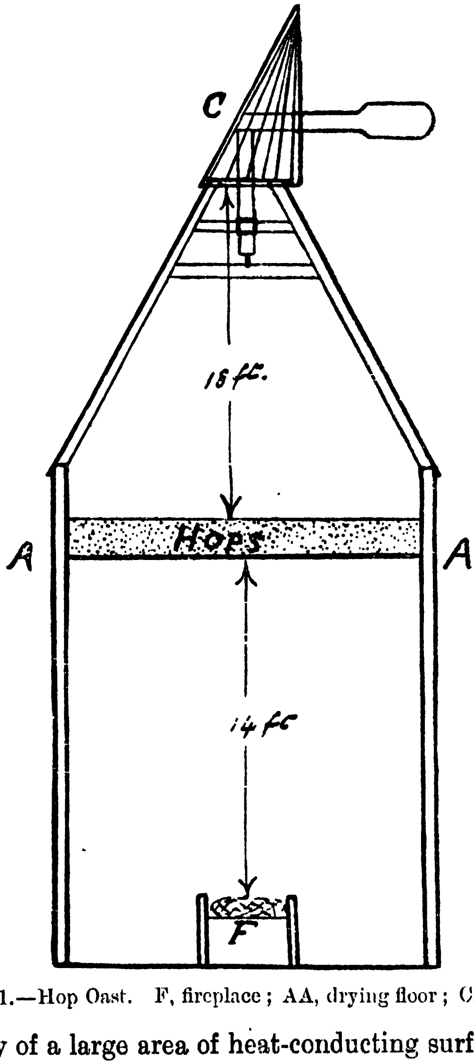

FIG. 1.—Hop Oast. F, fireplace; AA, drying floor; C, cowl.

mon property of a large area of heat-conducting surface by means of which the drying air is heated before passing through the hops; the stove is generally within the kiln and the products of combustion are led through a complex system of iron pipes below the drying floor before passing to a chimney through which the smoke, etc., is evacuated without passing through the hops.

The "cockle" kiln, now obsolete, was the most primitive type of these closed kilns.

In America closed kilns are everywhere used; they are generally built of wood and are higher than the usual English type of kiln. In England stove kilns are generally operated by artificial fan draught, the best known type being that designed by E. G. Shew, of Herefordshire.

These stove kilns, as stated above, enjoy the great advantage of cheap fuel. In the Royal Agricultural Society's trials referred to below, it was shown that on the average of the season the output of dry hops per 1 cwt. of coke consumed was exactly 1 cwt., which compares favourably with the weight of anthracite coal commonly required for hop drying, generally regarded as between $\frac{3}{4}$ and 1 cwt. per 1 cwt. of dry hops, especially when the cost is taken into account.

The disadvantage of these systems is the extra capital involved and the rapid wear and tear to which the stove and pipes are subject. The labour involved in stoking such kilns is not greatly different from that in the open-fire kilns; the installation, therefore, of some such stove-kiln system is well worth the consideration of any grower who contemplates the erection of new oasts. The decision can be based upon prices prevailing at the time.

Other forms of hot-air drying have been tried in which the drying air has been caused to pass through a battery of pipes, heated sometimes by steam and sometimes directly from the products of combustion, situated outside the kiln. These types have not made much headway probably because of the inevitable wastage of heat involved.

Fan-draught.—The fan method of controlling draught has been applied both to stove kilns and to open-fire kilns in a variety of ways, and undoubtedly gives the drier absolute control in the oast. A drier provided with fan-draught and with thermometers should make no mistake, provided he takes reasonable precautions. There are several possibilities in the method of driving and utilising the fan; it may be belt driven or electrically driven and it may be placed above or below the hops. If the fan is belt driven it is generally situated below the hops to drive air into the kiln because it is more convenient to fix and drive in this way. When the fan is fixed below it is most important to provide adequate openings above the hops for the escape of the air since otherwise the fan is working against unnecessary resistance, but when kilns that have served for open-fire methods are converted, it not infrequently happens that this provision is omitted.

* An account of this and three other types of hot air kilns is given in "The Trials of Hop Drying Plant" in the *Journal of the Royal Agricultural Society* for 1909.

A further consequence of forced draught is the tendency for the products of the burning brimstone to be forced from the kiln throughout the oast, making the place untenable for the men engaged in "pressing," etc.; this is aggravated when sufficient outlets, mentioned above, are wanting. Very careful ceiling of the partitions between the cooling floor of the oast and the kilns is therefore necessary.

When the fans are electrically driven they can be fixed in any desired place and this is generally in the roof of the kiln some few feet (6 or 8) above the level of the hops so that the suction may not create a greater draught through the hops near the fan than elsewhere. In this position it is essential that the remainder of the roof area shall be very perfectly ceiled since otherwise any leakage of air through the roof will lessen the efficiency of the draught through the hops. By such an arrangement of the fan the difficulties associated with the interference of work by the fumes of the brimstone are, of course, obviated and it is generally found that drying is more uniform over the drying floor.

If the fans are used in association with open fires suction draught is the only form which can be applied, whereas with the closed stove it is immaterial whether forced or suction draught is utilised.

Source of Power.—There can be no question when a reliable source of electric power, as from an electric power company, is available that this will prove both most reliable and most economical. Where this is not the case either a portable steam engine or a fixed oil engine can be utilised to drive fans below the hops through a belt transmission. In some cases even it may be desirable where power is largely required for other farm purposes to drive the fans electrically from a fixed oil engine in some central position on the farm. Each case will need to be considered on its merits with the help of competent engineering advice.

Modifications in Drying Practice when Fan-Draught is Used. —*Loading.*—Generally when fan-draught is used, and provided the fan power and area of fireplace are sufficient, the load can be doubled and when hops are ripe the depth may amount to 18 in. to 22 in. Greater depths may be loaded and dried successfully but no useful purpose is served because the rate of drying is slow and the kilns cannot complete the drying of two loadings in 24 hours. When hops are unripe the load should be reduced

proportionately. With such deep loads it is most important to level the hops with the greatest accuracy upon the drying-floor.

Temperature.—Substantially the same range of temperatures applies for fan draught as for natural draught. There is the same danger of "reeking" at the beginning if the temperature rises too quickly, but this is not quite so acute because the power of the fan is equal throughout drying (as great at the beginning as at the end), whereas with the open fires the draught increases as the oast warms up. For this reason it is permissible to start drying at a temperature 5 or 10 degrees in advance of that recommended for open fire drying. That is to say a start may be made at 105° instead of the recognised 100° F. for open fires; but the temperature must not rise more rapidly with the fan draught and the same period must elapse before 140° F. is reached or misfortunes will arise in the shape of discoloured hops. Again the temperature may be raised to 150° or 155° F. after "feathering" to expedite the finish. Though this high finishing temperature is permissible, some careful growers place the maximum for fan drying at 140° or even 130° F. and by so doing contend that they retain more of the volatile oils and produce a softer textured sample.

Turning.—Fan-dried hops can be finished without turning just as hops over the open fires can be so dried, but undoubtedly turning expedites the finish and provided the operation can be done without undue smashing of the cones is a wise operation. From the nature of the case, however, with such a depth of hops on the floor it is not an easy operation. Where facilities permit a trolley constructed to run backwards and forwards on runners above the hops enables turning to be accomplished without treading amongst them.

Control of Fires.—In the case of stove kilns the fan draught does not affect the combustion inside the stove, but where fan draught is associated with the open fire it introduces a disturbing factor because the quick draught causes the fires to burn through very rapidly and so necessitates much more frequent stoking and attention to ensure a steady temperature. A common fault with such kilns is the inadequate size of fireplaces. These should preferably be 3 times the area of similar fireplaces for the same kiln with natural draught; then the fires can be made up to burn more slowly and regularly and if the whole area of fireplace is not required it need not be used. Another consequence of fan-draught with open fires is the necessity of ensuring efficient mixing of the hot and cold air entering the

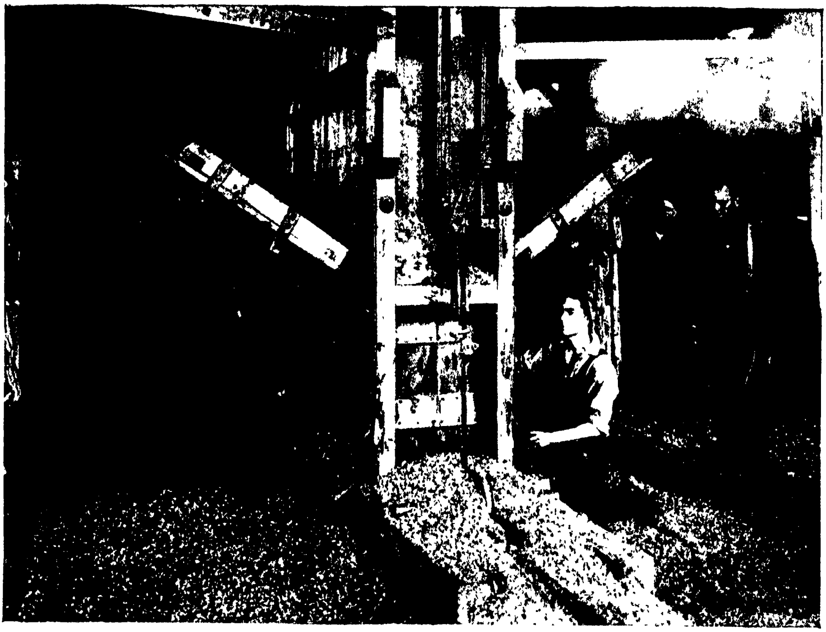

FIG. 2.—Baling Press, showing Hops pressed ready to close the bale.

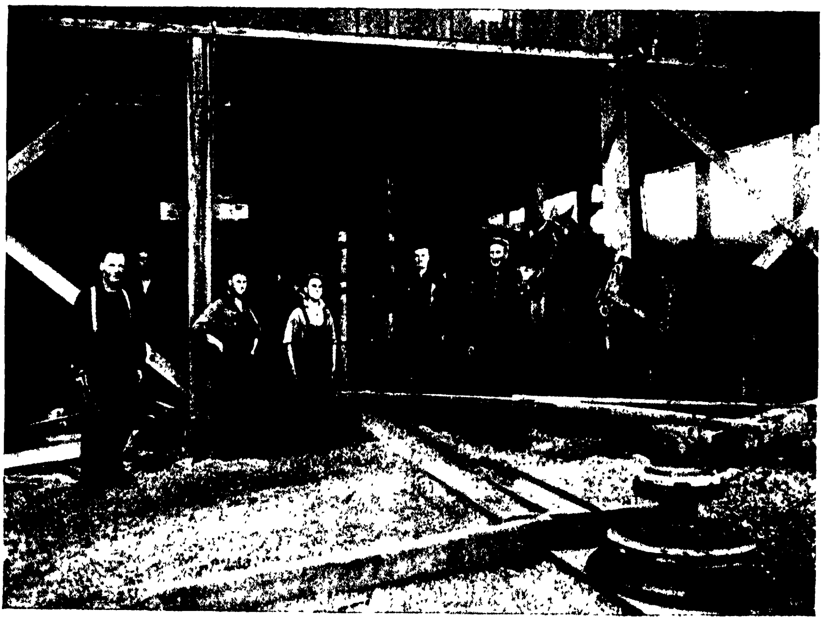

FIG. 3.—Windlass for Pressing.

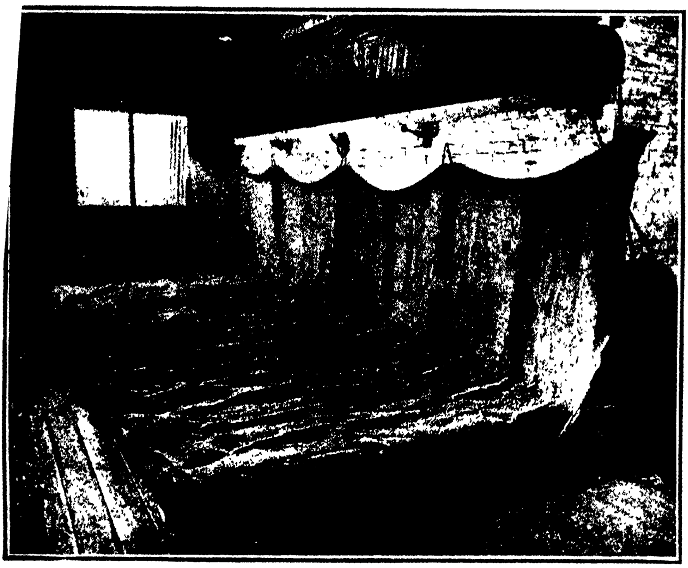

FIG. 4.—Showing False Floor and Coconut Matting for cooling deep layers of Dry Hops.

kiln, otherwise the air passing some parts of the drying floor may be 5 or even 10 degrees hotter than that at others. This mixing of the hot and cold air may best be attained by so arranging the stucture of each fireplace that large quantities of cold air can enter above as well as below the fire bars.

In addition to this a baffle-plate should always be supported immediately above the fireplace to prevent direct radiation from hot places in the fire to the drying floor. The baffle-plate should be supported upon perforated brickwork, constructed so that the perforations are very numerous and that the warm air can readily pass through the wall. Under these conditions it will not generally be necessary to let much cold air directly into the oast, except for purposes of cooling, and the mixing of the air as described will ensure uniform temperature.

Sulphuring.—When the fans are running the fumes of the burnt sulphur pass much more rapidly through the hops and therefore produce less effect; in view of this some people have advocated running the fans at a slower rate for the first hour whilst the sulphur is burning. This of course hinders drying and is therefore disadvantageous and may result in some precipitation of "reek" unless the temperature is down well below 100° F. Probably a better plan is to allow the fans to run at full speed from the start of drying and to allow larger quantities of brimstone to be burnt, amounting to 1 lb. to 20 or 30 sq. ft. of drying floor.

Control of Draught.—This is a simple matter. Usually the fans should be kept running at the maximum speed from the commencement to the end of drying except in the case when the hops are turned shortly before the finish. When this is done the resistance to the passage of the air is greatly reduced, less suction is necessary and the speed may well be slackened by 20 per cent., so that power and fuel may be economised.

Management after Drying.—When the hops are dry and cooled down to about 110° F. they are unloaded to the cooling and packing floor; in this operation great care must be taken not to break them unnecessarily or a "chippy" sample will result, for the hops are now extremely brittle. The best method consists in the use of false floors by means of which the hops can be unloaded without the necessity of handling them with scoop and broom. There are two such alternatives, the patent Hetherington floor, by means of which the drying floor cloth is wound off bodily to one side of the kiln and the hops drop down

during the process to a heap on the cooling floor, or small horse-hair "lifter cloths," 4 yd. by 6 yd., may be spread on the drying floor before each loading and lifted and discharged through the oast door at the finish. In the general case, however, no such false-floor is available, and the hops have to be swept off the floor with scoop and broom, and are consequently liable to damage if roughly handled.

As soon as the hops are unloaded they should be spread abroad over the cooling floor nominally to cool, but much more importantly to re-absorb some water and become less brittle, so that when pressed into the hop-pockets they may retain their original structure without breaking.

In cases where natural draught kilns have been converted to fan-draught and the output of dried hops has been doubled without adding to the cooling floor, a considerable difficulty may arise in cooling the hops owing to the increased depth upon the floor; in this case delay may be occasioned in packing or the hops may have to be packed while still warm and brittle, thus occasioning both loss in quality and also in weight. This difficulty may be overcome by allowing access of air to the bottom of the heap, in which case the hot air amongst the hot hops rises and sucks the cool air in from below. The best way of accomplishing this is to construct a false wooden floor upon wooden runners about 6 in. high with 2 in. slats spaced $1\frac{1}{2}$ in. apart. Upon such a false floor a depth of hops 3 or 4 ft. deep will cool as quickly as a depth 12 to 15 in. deep on a close-boarded floor. It is convenient to spread a loosely-woven cocoanut matting sheet over the false floor before unloading, so that the cool hops can be easily moved off the false floor for packing.

Packing.—Considerable judgment is required on the part of the drier so that his hops may be ready for packing in an ideal condition. They should be "home-dried," whole and soft to the touch with the requisite quantity of re-absorbed water. If by accident the hops have been unloaded before they were quite dry and contain a small proportion of hops with tough or sappy strigs they should not be spread abroad to cool but kept in a big heap and covered over with cloths so that the dry hops take up some moisture from those which are not dry. If they were dried too much they should be given extra time to cool and so to gain weight. On the other hand if left too long on the cooling floor in damp weather hops may absorb too much water vapour, in which case they become sour on keeping and are said to be "cold packed."

In England hops are pressed into tall cylindrical pockets for marketing, whereas on the Continent and in America the hops are universally marketed in rectangular bales. The former are awkward to handle, awkward to load upon wagons and on rail, and are by no means economical of labour in filling; the pocket has to be many times filled and the hops as many times slowly compacted with the foot of the press. The rectangular baling press, generally operated by horse power, completes the pressing in three or four operations and is much more expeditious. It is of course readily admitted that it is hardly possible to contemplate scrapping the circular presses indiscriminately, but it does seem desirable that the relative economy of the two methods should be carefully examined, and a useful purpose might be served if the Royal Agricultural Society, when it next meets near a hop-growing centre, offered a prize for the most economical design for power pressing.

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THE ORCHARDS OF MIDDLESEX.

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MIDDLESEX is one of the oldest if not the oldest of the country's commercial fruit-growing counties. Its proximity to the London markets, and the fertile alluvial soils of the valleys of the Thames and the Lea, have attracted fruit growers for many generations, and there is no doubt that in early days, when transport was confined to horse traffic, the Metropolis looked to Middlesex for the bulk of its fruit supplies. With the advent of modern transport, however, and the gradual overflow of Greater London into the best fruit districts, the county has lost many of its privileges, although it holds its own, and the cultivation of fruit is still a flourishing industry.

The old fruit-growing area of the county was the Thames Valley from Fulham and Hammersmith to Twickenham, including Chiswick, Brentford and Isleworth. The parishes of Isleworth and Brentford still contain some of the best orchards of the county, but during the past half-century the growth of the residential districts and the building of factories, the expiration of leases, and the increasing value of land, have pushed the fruit growers further west, and orchards have been planted over the extensive flat area, roughly 40 square miles in extent, of which the village of Feltham is about the centre. On the colder

and heavier soils of the northern half of the county very little commercial fruit-growing is attempted, except in the Enfield district of the Lea Valley, which contains some of the most productive orchards in the county. Here again, however, the activities of the builder, and the extensive brick-fields of the locality, are gradually crowding out the fruit grower and market gardener.

There is still plenty of room in West Middlesex for the development of fruit plantations, and with the excellent marketing facilities and favourable natural conditions, one might have expected the industry to increase and keep well up-to-date; but the facts are rather the reverse. The same markets and conditions are equally favourable to commercial vegetable growing, and while the latter has attracted new growers and gradually increased, fruit-growing appears to be steadily declining, or perhaps it would be more correct to say that the planting of young orchards is not keeping pace with the demolition of the old ones in the urban districts.

The Agricultural Returns give the following figures for Middlesex :—

	1910.		1920.		
	Acres.		*Acres.*		*Acres.*
Apples	1,115	...	998	decrease	117
Pears	438	...	262	,,	176
Cherries	166	...	87	,,	79
Plums	725	...	545	,,	180
Mixed Orchards	2,901	...	3,103	increase	202
Total Orchards	5,345		4,995	Decrease	350 acres.
Small Fruits*	4,139	...	1,939	decrease	2,200

As regards fruit it will be observed that the only increase shown above is that of 202 acres of mixed orchards. This would be largely accounted for by the fact that orchards which originally consisted of one kind of fruit only have since been replenished with other kinds and become "mixed."

Many of the plantations are hopelessly mixed, and it is almost impossible to say what they consist of. Apparently for many years, as one tree has died, another, often of a different kind, has been planted, with the result that one finds, not merely mixed varieties of apples, etc., but apples, plums, and pears all mixed together without any ordered arrangement. On the other hand, plantations are by no means uncommon, which for uni-

* The acreage of land on which small fruit is grown under orchard trees is included both as small fruit and as orchards.

formity and systematic arrangement would compare favourably with any orchards in the country.

All the more popular hardy fruits, with the exception of strawberries, are well represented in the county.

Apples.—Middlesex has not always been regarded as an apple-growing county, but of late years the planting of apples has increased, with good results. The above figures, showing a decrease of 117 acres of apples, are slightly misleading when this fruit is considered alone, as in many of the mixed orchards apples are in the majority, and the probability is that during the period under review the actual area under apples was increased. Some of the older apple orchards are not now profitable, as too many old and unsuitable varieties are grown which might well be replaced with better and more profitable varieties.

Of the dessert varieties, Beauty of Bath, Gladstone, Worcester Pearmain, Allington Pippin, and Duchess Favourite do well in most parts of the county, while amongst the culinary varieties Lane's Prince Albert, Stirling Castle, Lord Derby, Bramley's Seedling, Ecklinville, and Newton Wonder, are equally at home. On the lighter soils of the Thames Valley most of the choicer dessert varieties do well. Between thirty and forty years ago the late William Whiteley planted a large model orchard at Hanworth, including many of the best varieties of apples, such as Cox's Orange Pippin, Ribston, and King of the Pippins, which are still in excellent condition and cropping well. The adjoining district of Hampton has also long been famous for its fine quality "Cox's," many of which annually give a good account of themselves on the exhibition tables. Further north at Heathrow, may be seen well-kept established apple orchards running into hundreds of acres, which are yielding good crops. They suffered badly during last summer's drought, owing to the light soils and rather exposed position, but generally the quality of the fruit compares well with that of any other district.

In some parts of the county James Grieve, Rival, Wealthy, and other modern varieties are now being planted.

Pears.—Pears are extensively grown in all the fruit areas of the county, particularly Hazel, Windsor, Clapp's Favourite, Fertility, Lammas, and other market varieties. It is a peculiarity of the Hazel (or Hessle) pear that it appears to do better in close proximity to large towns than in the open country. In the urban districts of Middlesex very old trees of this variety are still producing good crops of excellent quality fruit. Apparently much remains to be learnt as to the cropping qualities of pears, as

many unsuitable varieties have been planted at different times. For example, an orchard at Shepperton contains a large number of trees about fifteen years old which have never yet borne fruit. In later years, Conference, and other choice varieties have been planted more freely.

Plums.—The plum has been regarded as the most profitable crop in Middlesex. Many good incomes and probably a few fortunes have been made out of the Victoria plum. Unfortunately plums seem to have fallen on bad times during the past decade. The vagaries of the spring climate have made plum growing very risky, as wet frosts during the flowering period seem to have become more frequent in recent years. Add to this the terrible scourge of silver-leaf, which has killed thousands of trees every year, and one cannot feel very optimistic as to the future of plum growing in the county. Middlesex has probably suffered more from silver-leaf disease than any other part of the country. Of the Victoria plum trees planted twenty years or more ago roughly 60 per cent. are now dead or beyond recovery. The Agricultural Returns show a decrease of 180 acres of plums in ten years, but these figures indicate only a small proportion of the loss due to silver-leaf, because the plum orchards, although their acreage may have changed but little, have all been drastically thinned during the past ten years and the actual number of trees has been greatly reduced.

Since the Silver-Leaf Order of 1919 came into force something like 100,000 trees have been grubbed up, and the commercial growers are making serious efforts to keep the disease in check. There are, however, many difficulties to meet. Large areas of orchard land have been cut up for building, and the old trees, many of them diseased, are often hidden away in the back gardens of private houses, to be a constant source of infection to neighbouring orchards.

A cure for silver-leaf and a thorough regeneration of stocks, may restore plum growing to its old prominence, but at present the outlook is anything but encouraging, and many growers are not replacing the lost trees.

The principal varieties grown are Victoria (the most profitable of all, but by far the most susceptible to silver-leaf), the Czar, Monarch, and Gisborne. Prince of Wales was once widely grown, but is not often planted now.

Cherries.—The cherry is no longer popular as a market crop in Middlesex. The official returns show a decrease of 79 acres during the ten years ending 1920. Of the remaining acreage, a

large proportion is made up by the batches of the Morello variety which are found in many of the larger orchards. Sweet cherries are not now grown to any great extent in the county but old, more or less derelict orchards here and there bear witness to the fact that cherry growing was at one time more popular. At Enfield in particular, "Cherry-Orchard Lane" together with an old orchard or two, and groups of ancient trees, remain to remind us of the days when cherry growing found favour in the district. Cherries, however, require a kindly season to bring them to perfection, and other crops are, no doubt, more reliable and profitable, with the result that cherries are not often planted now. Moreover, Middlesex does not possess a typical soil for this crop.

In the Slough and Langley district, which although just inside the Buckinghamshire boundary, is a continuation of the West Middlesex plain, there is a colony of several hundred acres of cherry orchards, where the industry is in a thriving condition, and young orchards are just coming into bearing. These orchards are of peculiar interest owing to the unusual system of letting. The land is owned by the Lord of the Manor of Langley, who has himself planted the fields with cherries. When the trees reach maturity they are let to growers, under conditions which include a certain amount of cleaning, manuring, etc., the owner letting separately or retaining for himself the grass under the trees for grazing purposes. Under this system the landlord is assured a fixed revenue, while the tenant harvests and markets his crop in the ordinary way, but requires practically no capital outlay. One of the results is that these orchards are among the best and cleanest of the country.

Undercrops.—Gooseberries, currants, and raspberries are grown as undercrops in many of the orchards, but in common with other fruits, their numbers have decreased during the last ten years. The greatest reduction is in black currants, which have in recent years been considerably injured by the currant mite (big bud). American gooseberry mildew has been responsible for the grubbing of large numbers of gooseberries, which are, however, one of the county's most reliable and profitable crops, and are again being freely planted.

In the western part of the county rhubarb and spring flowers are extensively cultivated under the trees. One large orchard, near Harlington, is entirely undercropped with peonies. Some of the orchards have no ground crops, but comparatively few are on grass.

Growers.—Middlesex has many first-class and up-to-date fruit growers, who have done much to improve the industry, and whose well-ordered plantations demonstrate the successful results of good husbandry. Unfortunately there are others whose cultural methods leave much to be desired, while a few have no methods at all, and rarely touch their orchards, except to gather the indifferent crop which the trees produce unaided.

It is only fair to add that many of these latter have mixed farms, fruit-growing being only one of their interests, and they cannot be expert in all branches. Further, the poor condition of many orchards is but a legacy of the late war; owing to the withdrawal of the necessary labour during the war period, many growers experienced great difficulties and were quite unable to keep their orchards clean.

In some cases, however, carelessness and lack of interest are evident, orchards being overcrowded and choked, and allowed to run entirely their own way. These growers have not observed the old saw, "a stitch in time saves nine." A clean orchard can be kept clean at a minimum of expense, but an accumulation of overgrowth and diseased wood so soon gets out of control that the orchard requires considerable capital outlay to get it into a productive condition again.

It is satisfactory to note, however, that during the past winter orchards have been thinned out and cleaned, and marked improvements are noticeable in many districts. Nevertheless, a great deal remains to be done in this direction, while spraying, grease-banding and other desirable operations are still the exception rather than the rule.

The fault appears to lie partly in the fact that some of the growers have "drifted" into the industry, without particular enthusiasm for it, with the result that technical knowledge has not developed. The real trouble, however, is undoubtedly the shortage of skilled labour. Fruit-growing, like any other trade or profession, cannot be successful without at least a leavening of highly skilled labour. Yet there are Middlesex fruit farms of a hundred acres where both owner and employees have not even an elementary knowledge of fruit growing.

It is fairly safe to say that *one* expert fruit grower to every fruit farm could double the output of high grade fruit. By expert is meant a man thoroughly and scientifically trained in all branches of fruit culture, who understands the principles of hygiene, and the management of an orchard from start to finish, including the grading, packing and marketing of the produce.

During the winter of 1920-21 two young apple orchards, which were on farms used as training centres for ex-soldiers, were utilised by Mr. J. Lawson, the Middlesex county instructor, who, by way of demonstration to the trainees, undertook to prune some of the trees. His treatment was thought by many to be too drastic, but his work was fully justified by last year's crop of fruit. Unfortunately only very approximate records were kept, and no figures are available; but as regards general appearance and quality of crop these two orchards stood out above any other similar orchards in the county. One orchard was visited by several interested parties, and some of the older growers expressed very high opinions of the crop. Doubtless the season would in any case have produced a good crop, but the result of Mr. Lawson's work was seen in the outstanding quality, size, and perfection of the fruit.

Crops of this kind ought to be, and could be the rule rather than the exception if there were sufficient skilled labour in the county, but the unfortunate fact is that few properly trained men exist at present, although the raw material is available. One frequently meets highly enthusiastic young employees on the fruit farms who if taken in hand by a capable instructor and carefully trained, could increase the value of their services tenfold.

* * * * * *

THE LARGE WHITE PIG.

SANDERS SPENCER.

ALTHOUGH some writers have essayed to describe the origin of the Large White breed of pigs, and one or two have even mentioned the names of two or three men who were interested in pig breeding some three score or more years ago as the founders of the Large White breed, it must be admitted that complete success does not appear to have attended their labours. Indeed, if a claim had been made some fifty years ago that there existed a distinct type of Large White pig it would have been most difficult to sustain it, for the simple reason that the white pigs found in Yorkshire and the adjoining counties had been so intermixed by the artisans and mill hands who were the most persistent and successful exhibitors at the many district shows, that it had become impossible to foretell with any degree of certainty the size and character of a resultant litter of pigs from the mating of white boars and sows.

In the sixties and early seventies the favourite system of mating was to select a thick fleshed boar of small size and with a short head, and to mate it with a sow of the largest size, possessing quality of bone, flesh and hair, a short face, and heavy jowls. As a rule there would not be the variation in size of the young pigs that might be anticipated, although later in life there might be a great difference in their development. The main reasons for this mode of procedure, which might not commend itself to pig breeders of the present day, were, that the fashionable pig of the period was one with a short head; that the wording of the prize schedules was usually "For the best white pig not exceeding certain fixed ages"; that the most popular pig classes were those for pigs not exceeding six or nine months old; that prize winning pigs in the classes for young pigs were always in great demand at good prices from agents and exhibitors at the Royal and other large shows; that those pigs not required for breeding could be readily made fit for slaughter either as fresh pork or as baconers as soon as the weather became cold enough; that as a rule the young pigs, the result of mating a small and compact boar with a large sow, possessed the outward appearance and character of the sire and also acquired the quick growth of the dam, and thus had a great advantage when shown in the classes for small white pigs, which then were probably the most fashionable type of pig and most readily sold at the highest prices.

It may appear strange to pig breeders of the present day that exhibitors of pigs should purchase at high prices pigs of such uncertain breeding which were almost sure to develop unevenly, but the conditions were quite different half a century ago from those existing to-day. In the first place there was no fixed type or qualification for Small, Middle or Large Yorkshires, as they were then termed. The pigs of all three breeds were supposed to have short heads; this was imperative with Smalls and Middles and almost universal amongst Large Yorkshires.

Mere size at the time of exhibition was the determining factor as to classification, so that it was possible for a white pig to pass and win as a Small Yorkshire when young and to develop so as to qualify subsequently for exhibition as a Middle White (or, as they were classified at the Royal Agricultural Society's show, as "a pig of any breed other than Berkshire, Small Black, Small Yorkshire, or Large Yorkshire"). Indeed it was declared that one pig was actually exhibited in all the three classes for White Yorkshires

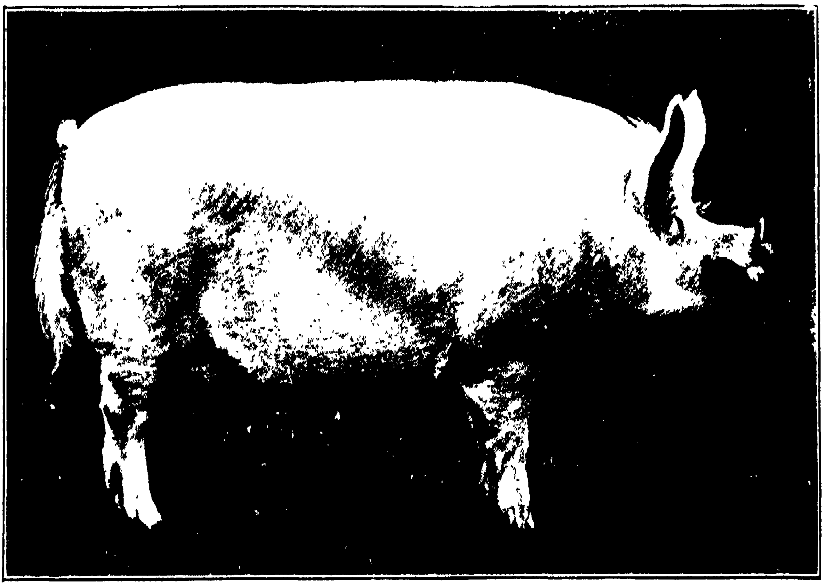

FIG. 1.—Larg

FIG. 2.—Large White Sow.

at different shows. It is within the knowledge of the writer that the same pig has won at the Royal as a Small Yorkshire and in the nondescript class, and that a pig has won in the latter class and then in later years has won as a Large Yorkshire. Any difficulty which might have arisen was easily overcome by entering a pig as "age and breeder unknown." This last practice had become so common, seven prizes for pigs so described having been won at one Royal show, that the buyers from the United States discussed the question in the American live stock papers and asked how any pigs of unknown descent could qualify in the classes for pigs of a defined breed and possessing a pedigree? This, and the difficulty, if not impossibility, of identifying white pigs and their breeders, were two of the chief causes of the establishment of the National Pig Breeders' Association some forty or more years ago. Some few years before the classification of Yorkshire pigs had been altered at the Royal Agricultural Society's shows, where prizes were offered for Small White pigs, Large White pigs, and Middle White pigs, and as scales of points had been drawn up, these with the registered pedigrees of the pigs entered, ensured to a considerable extent that the exhibits were accurately described and shown in the various classes. The comparatively short recorded pedigrees possessed by the pigs entered in the first few volumes afforded proof that the three varieties of Yorkshire pigs had not been bred on defined lines for any great length of time prior to the foundation of the herd book. Indeed it would be most difficult, if not impossible, to furnish proof that the Large White pig existed as a distinct and separate type before the seventies of last century.

About that period there was also a great change in the type of pig demanded by the purveyors of pork and especially by the bacon curers. Pigs furnishing a much smaller proportion of fat to lean meat were in more general demand. The introduction of the cold air system had enabled bacon curers to carry on operations with as great ease during the summer months as during winter, so the necessity ceased for salting heavily the bacon intended for consumption during the summer. The necessity for bacon pigs carrying a large proportion of fat to lean also ceased when the mild-curing system became possible with the aid of the cold air chambers. With the passing of the heavily salted lean portion of the bacon there sprung up an enormously increased demand for what has been termed "breakfast bacon," *i.e.*, lightly cured bacon carrying comparatively little fat and manufactured from pigs long in the carcass and thus affording the largest possible proportion of the middle portion of the side of bacon.

The bacon curers in these islands gave free expression in the public press to their requirements as to the form and degree of fatness of the pigs for which they were enabled to pay the highest price, so that the breeders of the various kinds of pigs had placed before them a model to which they might work up. The general body of pig breeders did not seem inclined to make any great alteration from the type of pig which they had been breeding, but one or two breeders of Large White pigs were apparently impressed with the fact that with some modification their favourite breed of pig could be made so that it would qualify as a bacon curer's pig. The jowl was lightened, the shoulders were made much lighter, the lean meat increased, the bone was made of finer quality, the form of the ham was improved and the quantity of fine hair increased. In the seventies of last century the Large White was a large pork pig, in the eighties and nineties it was a bacon pig. The so-called improved Large White and its crosses were tried by the home curers with satisfactory results; the bacon placed on the London and Manchester markets complied so much more nearly with the requirements and fancies of the consumer than did the imported bacon, that the manufacturers of bacon in Denmark purchased a considerable number of large white boars from a large herd in the Midland Counties. The results were so satisfactory that the Canadian curers sent orders for breeding pigs of the Large White breed to the same breeder. Eventually exports of Large White pigs of this distinct type were made to all those foreign countries where bacon curing is carried on to any extent.

The Large White pig had become so popular that foreigners whose native pigs were far too small and short, purchased at prices which were at the time considered to be exceedingly high, the largest pigs of the breed, those which were long in the face and high on leg. Unfortunately, owing to this, a large proportion of the breeders of Large Whites followed the example of the Berkshire breeders by studying the requirements of this limited proportion of the buyers of pure-bred pigs whose wants were of a special character, and by so doing rendered their pigs of considerably less value to the greater portion of their customers whose demands were for smaller fine joints from pigs which developed early. The breeders of Berkshires have restored their pigs to public favour and usefulness and there are clear signs of an awakening of the breeders of Large Whites to the fact that although fancy points help to sell a few pigs at high prices for a short period, the commercial market is of greater import-

ance and is more continuous. The number of breeders of Large Whites does not appear to have increased in recent years.

Although the sows of the Large White breed are at least the equals of sows of any other breed or cross in prolificacy, in milking, and in the general duties of motherhood, the strongest claim for popularity of the Large White pig probably rests on its wonderful capacity for crossing on pigs of almost any breed and rendering the joint produce suitable for the wants of the bacon curer. At the present time it is declared that no breed or cross of pigs so nearly supplies the wants of the manufacturer of the bacon which realises the highest price on our best markets and which is in the greatest demand than does the cross-bred pig produced by a Large White boar and a Large Black sow.

The National Pig Breeders' Association has published what is termed a standard of excellence which may be of some value but which might perhaps be of still greater assistance if the market and breeding value of each point had been stated. It is as follows:—

Colour.—White, free from black hairs and as free as possible from blue spots on the skin.
Head.—Moderately long, face slightly dished, snout broad, not too much turned up, jowl not too heavy, wide between the ears.
Ears.—Long, thin, slightly inclined forward and fringed with fine hair.
Neck.—Long and proportionately full to shoulders.
Chest.—Wide and deep.
Shoulders.—Level across the top, not too wide, free from coarseness.
Legs.—Straight and well set, level with the outside of the body, with flat bone.
Pasterns.—Short and springy.
Feet.—Strong, even and wide.
Back.—Long, level and wide from neck to rump.
Loin.—Broad.
Tail.—Set high, stout and long, but not coarse, with tassel of fine hair.
Sides.—Deep.
Ribs.—Well sprung.
Belly.—Full but not flabby, with straight underlines.
Flank.—Thick and well let down.
Quarters.—Long and wide.
Hams.—Broad, full, and deep to hocks.
Coat.—Long and moderately fine.
Action.—Firm and free.
Skin.—Not too thick, quite free from wrinkles.
Objections.—Black hairs, black spots, a curly coat, a coarse mane, short snout, inbent knees, hollowness at back of shoulders.

Large bred pigs do not fully develop their points until some months old, the pig often proving at a year or 15 months a much better animal than could be anticipated at 5 months and *vice versa*, but size and quality are most important.

THE CONTROL OF MAGGOTS ATTACKING THE ROOTS OF VEGETABLES.

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INSECT pests of vegetables have been very much neglected by research workers in this country, especially insects attacking onions and carrots, and to a less extent those injuring cabbages and turnips.

Cabbage Root Fly.—In America, where pests of vegetables receive much more attention, efforts have been made to devise a satisfactory means of control for the maggots of *Chortophila brassicae*, the cabbage root fly, which attack the roots of cabbages, cauliflowers, turnips, etc.

One of the methods of control recommended is the device known as the tarred felt "disc," which consists of a small square of ordinary tarred roofing felt which is slit in the manner shown in the diagram.* These squares are placed round the stem of the plant at the time of planting out in the field and act mechanically in preventing the fly from laying her eggs on the plant. To place the square in position, the main slit is opened and the two flaps in the centre are lifted up; it can then be slipped round the stem and pressed down close around it. The squares must lie flat on the soil to be correctly applied, and the soil should be in a friable condition to enable them to do so. They should be about 2½ in. square and can be cut from a sheet of tarred felt with a sharp knife. It is important that the material used should be tarred roofing felt and not the thin paper sometimes sold as felt.

As regards preventive measures for this fly by means of chemicals, good results have been obtained by using ordinary creosote applied to the plants, mixed with some substance like dry soil or precipitated chalk to act as a "carrier" or "spreader" of the creosote. It is inadvisable to use sand as the spreader because it does not absorb the chemical. The proportions should be two parts by weight of creosote to ninety-eight parts of chalk or earth. If possible precipitated chalk should be used as the spreader, as it takes up the chemical readily, is easily applied, and is cheap. In order to obtain the correct proportions of the mixture it is better to weigh out the respective

* See also this *Journal*, April, 1918, p. 59.

amounts of creosote and chalk. A quarter of an ounce of creosote to 12 oz. of chalk gives the correct proportion, and in recent trials it was found that 2½ lb. of the mixture was sufficient for each square rod (or, say, 30 square yards). To mix the two together, the chalk can be put into a tin bath or similar receptacle and the creosote added slowly, the chalk being continuously stirred. The mixture should be applied in spring after the plants are set out, being dusted round the seedlings by using either a powder sprayer or a strong paper bag with a hole in one corner. Two or three applications should be given at fortnightly intervals.

A third method of control, which has given good results in America is treatment with *corrosive sublimate*. A solution of 1 oz. in 10 gal. of water should be made, and as the sublimate requires a little heat to make it dissolve, it should be dissolved first in a small quantity of hot water and then made up to ten gallons. As it is poisonous it should be used with care. About a tea-cup-full should be applied to each plant as soon as the plants are set out, and four applications given at intervals of a week or ten days.

Onion Fly.—The onion fly (*Hylemyia antiqua*), like the cabbage root fly, usually lays its eggs upon the plant and not in the soil. Any chemicals used as insecticides against this fly should be in the nature of deterrents to keep the fly away and prevent it laying its eggs, as once the maggots have got into the bulb of the onion it is too late to eradicate them. No such mechanical device as the tarred felt disc is practicable, however, and we must look to other measures for its control.

Experiments have been made with varying success. The worst damage is done when the onions are in the seedling stage, as the maggots are capable of killing several onions by migrating from plant to plant. Any insecticide must therefore be applied in early spring soon after the onions appear above the ground. It is recommended that the fields be dusted in early spring, when the onions are two inches long. with a mixture of dry earth or precipitated chalk and green tar oil, in the proportions of one part by weight of oil to ninety-nine parts of chalk or dry earth (say ¼ oz. to every 1½ lb. chalk). Several applications should be given at intervals of a fortnight. The materials may be mixed and applied in the same manner as for cabbage root maggot.

The corrosive sublimate solution used against the cabbage root maggot is well worth trying in this case also. Soot, which

is so often recommended as a remedy for the onion fly, has proved entirely inadequate.

Heavy applications of nitrate of soda or of some similar stimulant have been found in practice to prove very beneficial in enabling the onion to withstand attacks by the onion maggot. In recent experiments it was found that of two exactly similar plots of onions, one of which was treated with nitrate and the other left untreated, the former gave 64 lb. of clean onions as compared with 32 lb. on the latter.

Carrot Fly.—For the carrot fly (*Psila rosae*) remedies must be applied early in the season when the carrots are a few inches long and before the fly lays her eggs. The chief point of difference between the life history of this insect and that of the onion and cabbage root flies lies in the manner of egg-laying, the eggs being deposited in the soil and not on the plant. Bearing this fact in mind it will be seen that if the soil is dusted over with a thin covering of chalk or earth impregnated with some insecticide, the fly is likely to be deterred from egg-laying, while even if the egg is laid, the tiny maggot may be killed by the chemical on its journey from the egg to the carrot root. In practice it was found that green tar oil, chlor-cresylic acid, or nitro-benzene, gave the best results, when applied mixed with precipitated chalk at the rate of ¼ oz. of the chemical to 1½ lb. of the chalk. It should be mixed and applied as in the other cases.

In captivity the carrot fly has shown a very great fondness for sugar and will continue to feed upon it till the abdomen bursts and the insect dies. It might be worth while in gardens and allotments to put out a small quantity of syrup or molasses to attract the flies away from the carrots. Whenever possible carrots should be sown late, about the end of the first week in May, as by this means the first generation of flies is avoided and the risk of infection thereby lessened.

* * * * * *

The Sex of Eggs.

INVESTIGATIONS into a means of increasing the proportion of hens to cocks in hatchings were described in a communication by M. Lienhart of the University of Nancy,* made to the Académie des Sciences in 1919. Starting from the facts that in the same breed cocks are heavier than hens, that the weight of young male chickens is higher than that of females, and that the same difference is perceptible even in newly-hatched chicks, it occurred to Mr.

* See *Journal d'Agriculture Pratique*, 14th Aug., 1919.

Lienhart that the eggs from which male birds are developed might also be heavier than those producing females.

Experiments which he then made did appear to show that by selecting for incubating eggs heavier than the average a larger proportion than usual of male birds was produced. This was only the case, however, when eggs of a single pure breed were used. and it appeared that the result would be more certain if eggs were used from fowls all of the same age and at the height of the laying season.

Further experiments at the Experimental Station of Coligny (France) have given the following results* :—

Sitting of	15 eggs,	medium weight, rather light,	8 hens,	4	cocks.
„ „	15 „	„ „ „ heavy,	4 „	7	„
„ „	15 „	all heavy	4 „	9	„
„ „	15 „	light weight (below average)	9 „	3	„
„ „	15 „	(from 5 hens) lightest weight	11 „	2	„

Other experiments gave negative results and M. Lienhart found† that these were always obtained with breeds of mixed origin, such as Faverolles, Mantes, Coucous de Malines, etc. With Leghorn, Minorca and Bresse eggs, a large proportion of males with heavy eggs, and a large proportion of females with light eggs, were always obtained.

In reality, the progenitors of the Faverolles had very different weight averages of eggs :—Houdan 1.94 oz., Brahma 1.87 oz., Dorking 2.19 oz. It follows that certain families of Faverolles have eggs approaching Houdan eggs, others Brahma eggs, and others again Dorking eggs. If then, light Faverolles eggs (average weight 2.12 oz.) are selected to obtain females, one may include in the sitting heavy eggs of the Houdan type or Brahma type and consequently obtain males. With eggs from a single Faverolles hen, however, of which the eggs were of a constant average weight, M. Lienhart obtained a majority of males with the heavier weights and vice versa.

These results are sufficient to encourage further investigation into the possibility of making, under practical conditions, such a selection of eggs for sitting that a large proportion of the sex desired may be obtained.

* * * * * *

* *Journal d'Agriculture Pratique*, 25th Feb., 1922.

† *Bulletin de la Société de Biologie*, No. 36, 10th Dec., 1921.

Plans for a Goat House.

CONSIDERABLE interest was shown in the Ministry's exhibit at the last National Utility Poultry Society's Show, of a model house for two goats and a fodder store combined. The model was designed to illustrate how goats could be housed under the most hygienic conditions with due consideration to economy of space and material. Detailed plans of the model have now been prepared and copies may be obtained from the Offices of the Ministry, 10 Whitehall Place, S.W.1, price 3d. post free.

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NOTICES OF BOOKS.

Crops and Tillage.—(J. C. Newsham, Principal of the Monmouthshire Agricultural Institution, Usk; pp. 182; 6s. net: Methuen & Co., Ltd., London.) This is a textbook which should attract a wide range of readers. It is written in a manner which must appeal to the farmer, and particularly to the farm student, yet it may also be described as a book for the University student who, after reading extensively, desires to focus his knowledge of the subjects coming within its title. In handling a scientific subject there is always the problem of technical words, but the writer manages to make his statements clear, without labouring to explain their evident truth when such would involve a standard of scientific training beyond that of the readers for whom the book is intended. The information is well knitted together, as, for example, in the description of the development of rotations as now practised, and the reader finds himself more and more interested as the subject matter is unfolded. The writer's experience is wide and drawn from many districts, and the book should prompt the farmer to try methods of cultivation which have proved successful elsewhere than in his immediate neighbourhood. Points of practical interest to the farm student, such as occur for example in threshing, stacking, sowing, rolling, in fact, in the most everyday operations, are dealt with in a manner most likely to impress the memory. Being recently written, the book embodies much of the experience, and many of the lessons of war-time cultivation. The writer wisely introduces much information which a farmer, from its very familiarity, often never thinks of explaining to a pupil. The index is good, but is unfortunate that it is not fuller. Several references are made to experiments, and to the works of agricultural writers, but a brief list of books of reference would have been an advantage. The pages on grassland and its problems are very good and give a well-balanced summary of the writer's experience, incidentally, it may be noted, he urges the value of liming rough pasture previous to the application of slag if the best results are to be obtained. Perhaps more might have been said about weeds without stepping beyond the title of the book. Several insect pests are touched on, and some fungus diseases. On points like these a list of references would have been useful and would not materially have increased the number of pages.

Commercial Poultry Farming.—(T. W. Toovey.) It is now three years since the first edition of Mr. Toovey's book was published, and the present edition has been entirely rewritten and many additional illustrations have been included. A book of this nature cannot fail to be of great value to all interested in commercial poultry farming, as it contains in detail and in a very clear manner the methods employed at the King's Langley Poultry Farm. Mr. Toovey has devoted many years to the study of this branch of agriculture, which is a growing an important one in this country.

In recent years commercial egg farms have sprung up all over the country, but in nearly every case they have been modelled more or less on the methods employed in the United States and Canada, altered somewhat to suit climatic variations on this side of the Atlantic.

Mr. Toovey's system departs largely from the usual practice, and in many ways may be said to be unique, especially so with regard to what are perhaps the two most important branches, namely, hatching and rearing, on which the success of a poultry farm so largely depends. Some 6,000 head of laying stock are run on this farm and the whole of the hatching and rearing is carried out by means of broody hens. To those unacquainted with the excellent arrangements made by Mr. Toovey this method of hatching may appear a difficult task, as indeed it would be were it not for his system and the fact that a considerable proportion of the stock consists of "heavy" or sitting-breeds and first crosses.

Two other items in Mr. Toovey's management also differ considerably from the usual practice. The runs are entirely of grass and the soft mash feed contains a high proportion of vegetables, a part of the farm being set apart for their cultivation. The large scratching house system is employed for accommodating the breeding and laying stock, but the unit per house has been kept down to 150 head in the case of unmated flocks and 75 for breeding stock. The breeding stock have separate wired-in runs but the laying stock amounting to some 5,000 birds are given free range in one large paddock. Mr. Toovey has rendered great service to the poultry industry in the past by the very frank way in which he has contributed to the Press, relating not only his successes but the failures which he has at times encountered and successfully overcome. In particular the two last chapters in Mr. Toovey's book should be read by every intending poultry farmer. These two chapters deal with the economics of poultry keeping based on the author's experience, and also express his views as to the future part to be played by the poultry industry in general agriculture. These views should prove of considerable interest to British agriculturists.

* * * * * *

Agricultural Research Scholarships.—The Ministry invites applications for research scholarships in agricultural science. The number to be awarded will depend upon the qualifications of candidates and will not in any case exceed five. The scholarships are tenable for three years from 1st October, 1922, and are of the value of £200 per annum.

Applications must be received not later than 15th July, 1922, and must be made on the prescribed form, which, together with a copy of the conditions attaching to these scholarships, may be obtained from the Secretary, Ministry of Agriculture, Whitehall Place, S.W.1.

Fream Memorial Prize.—The Fream Memorial Prize, which is annually awarded by the Ministry to the candidate who obtains the highest marks in the examination for the National Diploma in Agriculture, has been won this year by Mr. Robert Laird of Lawthorn, Irvine, Ayrshire, a student of Glasgow University and the West of Scotland Agricultural College. The value of the prize this year is about £6 10s., which is to be devoted to the purchase of books.

Report of International Seed Testing Congress.—Copies of the Report of the International Seed Testing Congress which took place at Copenhagen in June, 1921, will shortly be obtainable from the Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge. The price of the Report will be 6/- post free.

All those who propose to purchase copies should send their orders accompanied by a cheque or Postal Order to the above address as soon as possible, as the supply is limited.

Leaflets issued by the Ministry.—Since the date of the list given on page 188 of the May issue of the *Journal*, the following leaflets have been revised, and the one marked with an asterisk will, provisionally, be supplied free:—

No. 141.—The preparation and packing of Honey for Market.
" 244.—The Destruction of Rats.
" A 316/1.—Abridged List of Publications.*

The following leaflets are no longer supplied free:—

No. 381.—How to keep Swine Fever away.
" 383.—Hints on Goat-keeping.

Foot-and-Mouth Disease.—Since 23rd April, the date referred to in the Note contained in the *Journal* for May, 1922 (p. 103), only 16 further outbreaks of Foot-and-Mouth Disease have been confirmed in Great Britain, bringing the total up to 21st May to 1,099, of which 994 were in England, 3 in Wales and 102 in Scotland. Of these 20 outbreaks 1 occurred in Cheshire, 5 in Derbyshire, 1 in Denbighshire, 2 in Staffordshire, 8 in the West Riding of Yorkshire, 2 in Berwickshire and 1 in Midlothian. All these cases were dealt with by slaughter of the affected animals and those immediately in contact, involving the slaughter of a total of 401 cattle, 320 sheep and 122 pigs in the 20 outbreaks.

The outbreaks in Berwickshire and Midlothian occurred in free districts, and involved the reimposition of restrictions over an area of 15 miles radius from the infected centre. One of the outbreaks in Staffordshire and 1 in the West Riding, were near the border of a scheduled area, and involved small extensions of the areas under restrictions. Two of the outbreaks, viz., in Denbighshire and Midlothian, occurred on premises which had been previously infected but were freed and re-stocked.

Since 23rd April further modifications of the restrictions on the movement of animals have been made by Orders freeing large parts of Fife, Lanark, Renfrew, Westmorland, Cheshire, Norfolk, Lincolnshire (Lindsey), Lancashire, and parts of the 3 Ridings of Yorkshire, also freeing small areas in Northumberland, Cumberland, Essex, Middlesex, Perthshire, Forfar, Dumbartonshire, Durham, Nottinghamshire, Leicestershire and Warwickshire.

The following statement gives the number of outbreaks which have occurred since the commencement of the epidemic in January last up to 21st May, 1922, the date of the last outbreak in each county, the number of infected premises which have been declared free, and the number of animals slaughtered in each county.

County.	No. of out-breaks	No. of out-breaks freed.	Date of last out-break.	Animals slaughtered. Cattle.	Sheep.	Pigs.	Goats.
England.							
Bedford	1	1	3/2/22	44	—	–	—
Buckingham	1	1	2/3/22	8	—	—	—
Cambridge	2	2	8/2/22	82	—	61	1
Chester	43	41	26/4/22	1,214	48	180	—
Cumberland	5	5	25/2/22	303	80	—	—
Derby	17	6	21/5/22	313	1	35	—
Durham	75	73	8/4/22	1,190	409	215	8
Essex	16	13	29/3/22	325	537	381	—
Hants	1	1	7/2/22	5	—	·	—
Kent	3	3	3/3/22	57	163	1	—
Lancaster	105	98	6/4/22	1,723	141	838	2
Leicester	3	2	2/3/22	221	35	1	—
Lincs., Lindsey ...	33	33	21/3/22	825	1,745	358	—
do. Kesteven ...	1	1	2/2/22	17	25	—	1
London	2	2	17/2/22	39	—	—	—
Middlesex	6	3	9/4/22	198	—	155	—
Norfolk	23	23	26/3/22	576	461	488	3
Northumberland ...	38	37	17/4/22	1,200	508	186	—
Nottingham	20	19	28/3/22	372	159	86	—
Salop	1	1	1/2/22	41	—	1	—
Stafford	9	5	11/5/22	173	43	87	—
Suffolk	5	5	17/2/22	118	—	104	—
Surrey	1	1	9/2/22	—	—	—	—
Sussex, E.	1	1	21/2/22	—	—	–	–
Warwick	2	1	12/4/22	134	175	81	—
Westmorland ...	24	20	1/3/22	617	390	46	—
Yorks, E.R.	180	159	17/4/22	3,099	10,760	2,435	5
,, N.R.	104	90	11/4/22	2.759	2,736	841	2
,, W.R.	272	246	11/5/22	4,390	146	2,081	15
Total	994	893	—	20,043	18,862	8,664	37
Wales.							
Denbigh	3	2	26/4/22	43	—	14	—
Total	3	2	—	43	—	14	—
Scotland.							
Berwick	8	4	15/5/21	105	926	11	—
Dumbarton	4	4	16/3/22	105	61	29	—
Dumfries	1	1	4/2/22	84	—	1	—
East Lothian ...	3	3	16/3/22	108	--	25	—
Fife	8	6	13/3/22	226	1	19	2
Forfar	23	14	18/4/22	381	617	268	2
Kinross	1	1	23/2/22	13	—	1	—
Lanark	9	9	3/3/22	104	6	49	1
Linlithgow	1	1	11/2/22	43	—	—	—
Midlothian	11	9	14/5/22	914	—	174	1
Perth	10	9	21/3/22	435	107	23	1
Renfrew	16	14	4/3/22	291	16	47	—
Sterling	7	7	20/2/22	151	—	3	—
Total	102	81	—	2,960	1,734	650	7
Grand Total for Great Britain ...	**1,099**	**976**	—	**23,067**	**20,596**	**9,328**	**44**

Rabies.—*Southampton.*—A case of Rabies in a dog at Itchen, in the Borough of Southampton, was reported to the Ministry on 5th May. The head was received at the laboratory, and the case was confirmed on the 9th instant.

The dog, a fox terrier puppy, 7 months old, was not known to have bitten any other animal or any person. The owner states that he exercised the dog for miles over the country in the Southampton neighbourhood where outbreaks of Rabies occurred during 1920 and 1921. It is considered a possibility that infection may have been contracted from a rabid dog of the last series of outbreaks by some other dog, and communicated by a bite to the puppy now affected. No further information is available at the moment, but inquiries are being pursued as to any dogs lost or destroyed during the past 6 months.

An Order was made on 9th May, requiring the muzzling of all dogs within a radius of 15 miles from Southampton, and prohibiting the movement of all dogs out of that area except by licence of the Ministry. No licences will be granted except under conditions requiring the dog to be detained and isolated for 6 months on the premises of a veterinary surgeon approved by the Ministry.

Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE,
By Metchim & Son, Princes Street, Westminster, S.W.1. | 65...

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXIX. No. 4.

JULY, 1922.

NOTES FOR THE MONTH.

Prices and Supplies of Agricultural Produce in 1921.

THE Report on the Prices and Supplies of Agricultural Produce in 1921, which has now been issued by the Ministry, forms the Third and concluding Part of the Ministry's Agricultural Statistics for 1921. Part I of these Statistics dealt with the acreage under crops and the number of live stock in England and Wales, and Part II with the estimated production of the principal crops. The three parts taken together represent an endeavour to give information on the main points of economic interest affecting agriculture, and those who wish to take a comparative view of the changes in agricultural prices during 1921 will find much to interest them in the Report now issued. It also gives particulars of the work done by the Ministry in connection with the payment of claims under the Corn Production Acts. The total number of claims accepted was 187,000 and the area on which payment was made was 1,896,620 acres of wheat, 2,007,875 acres of oats, and 123,814 acres of mixed corn. The Report is published by H.M. Stationery Office and can be ordered through any bookseller.

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International Institute of Agriculture.

A MEETING of the General Assembly of the International Agricultural Institute was held at Rome in May last and was attended by representatives of 51 different countries. The questions discussed at this Meeting were largely of domestic interest, relating as they did to the financial position of the Institute, and the possibility of effecting certain improvements in its work, which without increasing the total expenditure would give the greatest result for the funds available. With this object a number of

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proposals were agreed to which will, it is hoped, tend to popularise the publications of the Institute.

Of the various Sections into which the work of the Institute is divided, the one which attracts most attention and is the most valuable is the Statistical Bureau. Briefly its work consists in publishing a monthly Bulletin, a Statistical Year Book, and special Reports on the Statistics of particular products, such as oilseeds. The work of this Bureau is remarkably well done and reflects the greatest credit on Professor Ricci, the Head of the Bureau, and on his staff. The Monthly Bulletin has for the past year or 18 months been issued in three parts, (a) Prices, (b) Production and (c) Imports and Exports, and the desire to make each of these parts as complete and perfect as possible has resulted in a very considerable increase in the size of the Bulletin. Whilst this enlargement enabled the Bureau to issue in a summarised form a complete statement of the available statistics received from all parts of the world, it necessarily involved considerable expense in printing. The Bulletin contained, moreover, two distinct classes of information. In the first place the section relating to production comprised the latest reports on crop prospects and crop yields in the different countries of the world, and included the best available information as to the supplies which were likely to be available in exporting countries and the probable requirements of importing countries. This section was therefore of direct and immediate value to the grain trade of the world by helping producers and distributors to form an accurate estimate of probable supply and demand. Notices are also issued at frequent intervals to the Press, and by this means the available information is spread broadcast throughout the world and is available for a very much larger public than is reached by the mere distribution of the Bulletin itself. The value of this side of the work is clear and is admitted on all hands.

In addition, however, the Bulletin contains records of prices ruling in the principal markets of the world, and also gives the latest available particulars of imports and exports with a view to showing how far the supplies of exporting countries are becoming exhausted, and the demands of importing countries are being met. These details whilst valuable for purposes of record and comparison are necessarily retrospective, and do not possess the same practical and current interest as those relating to crop production. It was felt that the Bulletin would gain in the estimation of the special public for whom it was intended by removing

from it everything that was not of immediate practical value and current interest, while at the same time this would enable it to be sold more cheaply. This does not mean that the information would cease to be issued but merely that it could without loss be included either in the Statistical Year Book or in a half-yearly publication. In the same way it was decided that the Bulletin of Technical and Economic Information now issued monthly could advantageously be altered in form and published as a quarterly review.

The satisfactory working out of the suggestions made at this Meeting in regard to the form of the publications is of vital importance to the future well-being of the Institute as it is in practice only through its publications that the Institute can appeal to the world and hence to the Governments by which it is supported. A development in the sale and popularity of its publications will be the strongest ground on which to base that demand for a permanent increase in its revenue which is a consequence of the decreased purchasing power of money.

It should, however, be borne in mind that much of the Institute's work must necessarily be gratuitous. The most striking example is found in the Statistical Bureau where the essential information obtained in the form of crop forecasts and crop yields is and must be distributed free through the Press. While in this way one of the main purposes for which the Institute was established is fulfilled, the benefits achieved cannot be precisely traced and are certainly not indicated by measuring the sale of the Bulletins or other publications.

That the Institute is well worth the small contributions made by the adhering Governments can hardly be questioned. At the present rate of exchange, the total cost expressed in English money is less than £40,000 per annum, towards which the British Government contributes only £3,200. In return, apart from the general and specialised information placed at the disposal of the agricultural and commercial public, the Institute actually provides much information, particularly in the direction of international statistics, which would otherwise have to be prepared by each Government separately at a far greater cost.

One decision reached at this Meeting which is of interest to English speaking countries was the adoption of English as one of the official languages of the Institute. There can be little doubt that this will tend to improve the position of the Institute in the eyes of the Anglo-Saxon world.

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International Year-Book of Agricultural Statistics.

THE International Institute of Agriculture at Rome has just issued a publication of 700 pages entitled the "International Year-Book of Agricultural Statistics for the years 1909 to 1921." It gives complete information as to the crop areas and yields in all the countries of the world, number of live stock, imports and exports, prices, freights, and the output and trade in fertilisers. It can be obtained direct from the International Institute of Agriculture, Rome, price 8s. post free. The money can be sent in the form of a British Postal Order. Copies will also be on sale shortly at the offices of the Ministry.

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Conciliation Committees in Agriculture.

THE total number of Conciliation Committee agreements at present in operation is 44, of which all but 3 are for periods extending over the corn harvest. Three agreements have been reached recently. The Committee for Cumberland and Westmorland have reached an agreement to operate up to 11th November providing for the payment of skilled men at the rate of 40s. for a week of "customary" hours (*i.e.*, 63 hours) and other adult male workers at 30s. for a week of 54 hours in summer (*i.e.*, up to the end of October) and 48 hours in winter. The Isle of Ely Committee have decided to extend their agreement which expired on 31st May up to 11th October, and in accordance with the Committee's application the agreement as extended has been confirmed by the Minister under Section 4 (3) of the Corn Production Acts (Repeal) Act. The Cambridgeshire Committee have now submitted the agreement which they reached last March to the Minister for confirmation. Particulars of these two confirmed agreements are given below. The effect of confirmation of an agreement by the Minister is to make the rates specified in the agreement an implied term of the contract of employment of every worker of the class to which the agreement applies. It will be noticed in the case of Cambridgeshire that the Committee have refrained from putting a definite period to the operation of the agreement, but have agreed that it shall stand until such time as either side of the Committee gives 21 days' notice of termination.

Isle of Ely Agreement:—

1. During the period up to 11th October, 1922, no male worker employed in agriculture shall be paid wages at less than the following rates :—

(a) Male Workers aged 18 *and over employed as horsemen or milkmen.*

Age.		s.	d.
21 and over	... ...	40	6
20 and under 21	... ...	37	9
19 " " 20	... ...	35	6
18 " " 19	... ...	34	3

for a week comprising the hours necessary for the performance of the customary duties of these classes of workers.

(b) All other male workers employed in agriculture.

Age.		Weekly wages for a week of 51 hours. s.	d.		Overtime rates, for all time in excess of 51 hours per week. d.
21 and over	... ...	31	0	...	8½
20 and under 21	... ...	28	9	...	8
19 " " 20	... ...	27	0	...	7½
18 " " 19	... ...	25	9	...	7
17 " " 18	... ...	20	6	...	5½
16 " " 17	... ...	16	3	...	5
15 " " 16	... ...	13	3	...	4½
14 " " 15	... ...	10	3	...	3
Under 14	... ...	7	3	...	2½

2. That the working week for summer months (*i.e.*, from the first Monday in March to the last Saturday in October) shall consist of 51 hours, and for next winter (*i.e.*, for the period other than the summer months) shall consist of 48 hours.

3. While no definite agreement is made regarding Saturday half-day, the employers will not put any obstacles in the way of farmers arranging with their workmen for a Saturday half-day after 51 hours have been worked, and this clause is to be carried out in a reasonable spirit.

Cambridgeshire Agreement:—

(*a*) A wage rate for all able-bodied male workers of 21 years of age and over of 7¼d. per hour for a week of 50 hours.

(*b*) A wage rate of 8d. per hour for all time worked between 50 and 54 hours per week.

(*c*) All work performed on Sunday to be paid for at the rate of 10d. per hour.

(*d*) All the rates specified to operate until twenty-one days after notice of any proposal to cancel is received by the Minister from either section of the Conciliation Committee.

(*e*) The Conciliation Committee strongly recommends farmers to offer facilities for one short day per week, the Workers' Side undertaking that workers shall not refuse to work on the short day for full time, in cases of necessity.

Information with regard to the position in any of the Conciliation Committee areas can be obtained on application to the Ministry, 10, Whitehall Place, S.W.1.

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The Agricultural Index Number.

THE index number of prices of agricultural produce in England and Wales shows a slight rise for May as compared with the previous month, prices on the average being about 70 per cent. above the pre-war level as against 68 per cent. in April and 112 per cent. in May, 1921.

The percentage increase each month since the beginning of 1919 as compared with the average of the years 1911-13, is shown in the following table:—

Month.	Percentage Increase. 1919.	1920.	1921.	1922.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
January	148	213	186	77
February	150	205	172	83
March	150	199	158	82
April	153	199	141	68
May	132	169	112	70
June	128	164	102	—
July	141	174	100	—
August	138	177	116	—
September	148	181	105	—
October	166	191	90	—
November	182	197	84	—
December	207	194	82	—

Wheat and oats were dearer during May than in April, the average prices during the month being the highest since last autumn. Barley continued the downward movement which has been in evidence since September last. A further slight advance was recorded for fat cattle, but sheep and pigs were slightly cheaper. The price of sheep after rising steadily throughout the year, reached the highest point at the beginning of the month and subsequently experienced an appreciable decline.

Among the principal alterations in prices as compared with the previous month were those in connection with milk and potatoes. The seasonal fall in milk prices from April to May reduced the average to 9½d. per gallon or only ¾d. per gallon higher than the average of the years 1911-13, although, as compared with summer prices in pre-war years, current rates show an increase of 2d. per gallon or about 27 per cent. Potatoes experienced a sharp rise from the latter part of April, and this was shown in the index figures for that month. This advance continued into the first half of May, and although prices subsequently fell considerably, the average of prices for May was about 170 per cent. above the pre-war level, as against 126 per cent. in April.

Among other produce, butter was again cheaper, while cheese showed little alteration. Eggs also fell in value but the decline was fully counter-balanced by the increase in the market value of poultry.

Feeding stuffs on the whole were inclined to be dearer in May than in April, except brewers' grains, which experienced a sharp decline; with this exception there was little difference between prices in April and in May. No material alteration in fertiliser prices was recorded, nitrate of soda again advancing slightly, while the lower grades of basic slag were somewhat reduced. On the average, prices for feeding stuffs and fertilisers during May were between 50 and 60 per cent. above the pre-war level.

* * * * * *

Distribution of Leaflets.

IN order to reduce expenditure on printing, the Ministry has been compelled to discontinue the free distribution of leaflets, and the small registration fees shown below will in future be payable by persons who wish to receive the leaflets as issued.

The leaflets are divided into four main groups dealing with the following subjects:—

I. Farm Live Stock (including Dairying, Feeding Stuffs, Pests and Diseases of Farm Animals).

II. Small Domestic Live Stock (Poultry, Rabbits, Bees, Goats, etc.)

III. Farm Crops (including Manures, Weeds, Pests and Diseases of Farm Crops).

IV. Garden Crops and Fruit Growing (including Manures, Weeds, Pests and Diseases of Garden Crops and Fruit Trees.

To receive NEW *Leaflets only.*

1. Of any one or two of the above groups - 1s. per annum.
2. Of any three groups or of all four groups 2s. ,,

To receive both NEW *and* REVISED *Leaflets.*

1. Of any one or two groups - - - 3s. ,,
2. Of any three or of all four groups - - 6s. ,,

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THE SCHOOL OF AGRICULTURE OF THE UNIVERSITY OF CAMBRIDGE.

PART II.

T. B. WOOD, C.B.E., M.A., F.I.C., F.R.S.,
Drapers' Professor of Agriculture and Fellow of Gonville and Caius College, Cambridge.

THE completion of the School of Agriculture opened a new era for agriculture in Cambridge. Until the end of 1909 the staff had been without a home of their own, and although they had received the greatest possible kindness and consideration from the heads of other scientific Departments, notably the Professors of Chemistry and Botany, the agricultural staff had undoubtedly been severely handicapped by deficient accommodation.

In January, 1910, the staff moved into their new building with a class of about 40 students. Immediately the number of students began to increase at the rate of about 25 additional students per annum, and in the academic year 1913-14 the total number of students receiving instruction in the School had reached 117, including about 30 candidates for the Diploma who had already taken the National Science Tripos, but exclusive of research students of whom there were about a dozen. Meantime other notable events had occurred. In 1910 the lease of the farm at Impington expired and it was decided to secure a farm nearer to the laboratories and the colleges so that the practical side of the teaching as well as the experimental work might be developed with less effort both to the staff and to the increasing number of students. Through the good offices of Trinity College the University was able to lease from the College for 10 years Gravel Hill Farm, consisting of about 200 acres of land situated between the Huntingdon and Madingley Roads within 1½ miles of the laboratory and not more than 1 mile from many of the colleges. To this area were added several adjoining fields hired from Clare College. The convenience of access of this farm has undoubtedly enabled Mr. Mackenzie and Mr. Amos, who have had charge of the teaching of husbandry, to develop the practical side of their teaching to a remarkable extent.

Unfortunately the demand for building sites on this side of the town makes it unlikely that the University will be able to retain the occupation of this farm, or to buy it from the College, at a price which would admit of its continued occupation as an agricultural holding. It is probable, therefore, that the agricul-

tural staff may shortly be compelled to seek another farm, and as continuity is the essence of field experiments, it is most desirable that funds should be available to enable the University to purchase a suitable farm and to equip it as a permanent station for teaching and research in plant and animal husbandry.

During the University's occupation of Gravel Hill Farm, Mr. K. J. J. Mackenzie has held the position of Director of the farm, an onerous and difficult office which he has filled with great success. His policy of maintaining pedigree herds of milking Shorthorn cattle, Suffolk sheep and Large White pigs, combined with a consistently high standard of production, has been justified by the intense interest of the students in the practical side of their work, and by the valuable results he and his assistants have obtained in animal husbandry in general and in swine husbandry in particular. In acknowledgment of the success of his labours he was given the status of University Lecturer in Agriculture in 1910, and was promoted to a Readership in 1915.

His Colleague, Mr. Amos, who has devoted his attention chiefly to crop husbandry, was given the status of University Lecturer in Agriculture in 1916. Mr. Amos has published much valuable work on clover sickness, on the cultivation of hops, and on ensilage.

About the time of the opening of the School, the University had consented to the inclusion of the physiology of farm animals as a compulsory subject in the examination for the diploma in agriculture, and the School was able to secure as lecturer in that subject Dr. F. H. A. Marshall, who had made his mark as an agricultural physiologist by his work on the causes of fertility and sterility among farm animals. Since his return to Cambridge, Dr. Marshall, now Reader in agricultural physiology, has continued his investigations and is now recognised as the leading authority on the physiology of reproduction.

At this stage it may be interesting to record the number of students of agriculture at the important epochs of the development of the School. In 1893, the first informal class numbered 7 students. In 1899, when the University Department of Agriculture was created, the total number of students was 20. In 1910, when the School was opened, the class just exceeded 40. In the spring of 1914, the numbers had risen to 117. Then the War came and the numbers fell rapidly to about 12. Immediately the Armistice was concluded there was a sudden rush of students. In October, 1919, over 200 freshmen joined the School, and by the end of the year the total number had risen to about 320, at

which level it still remains. This great influx of students necessitated a considerable reorganisation of curriculum, staff and buildings. A long range of army huts was hurriedly erected and fitted as lecture rooms and laboratories. Estate management and Horticulture were added to the subjects of instruction, Mr. F. B. Smith, C.M.G., being appointed Reader in Estate Management and Mr. C. W. B. Wright, N.D.H., Lecturer in Horticulture. The Gilbey Lectureship in the History and Economics of Agriculture was made into a full time office, the original endowment being supplemented from other sources. Lecturers were also appointed in agricultural zoology, agricultural law, veterinary science, accountancy, and statistics, the last jointly with the Department of Economics. An endowment collected by Sir Arthur Shipley made possible the appointment of a lecturer in tropical agriculture. These new appointments have increased the number of the teaching staff to 22, including two professors, four readers and four University lecturers.

At the same time the curriculum has been greatly extended, not only by the inclusion of the subjects mentioned above, but by the establishment of a definite three years' course of instruction in agriculture and allied subjects for the B.A. degree. Candidates for this course must become members of the University either by joining a College or by obtaining admission as non-collegiate students. They must also pass or obtain exemption from the previous examination, or Little Go, which comprises ordinary school subjects. The first year's course, which is the same for all students, aims chiefly at giving an all round introduction to agriculture and agricultural science. In the second and third years the subjects of instruction and examination vary according as the student is interested chiefly in agriculture, estate management, forestry, or horticulture. There is an examination at the end of each year. A student who has passed all three examinations is awarded the B.A. degree.

This degree course is designed to give a liberal education to prospective landowners, farmers, estate agents, foresters and horticulturists. It comprises not only agriculture, estate management, forestry or horticulture, and the allied sciences, but includes also lectures on agricultural history and economics, agricultural law and accountancy.

The examinations for the diploma in agriculture were formerly open to anyone. Candidates for the diploma must now be members of the University, and must possess a degree or some equivalent qualification gained either in Cambridge or elsewhere.

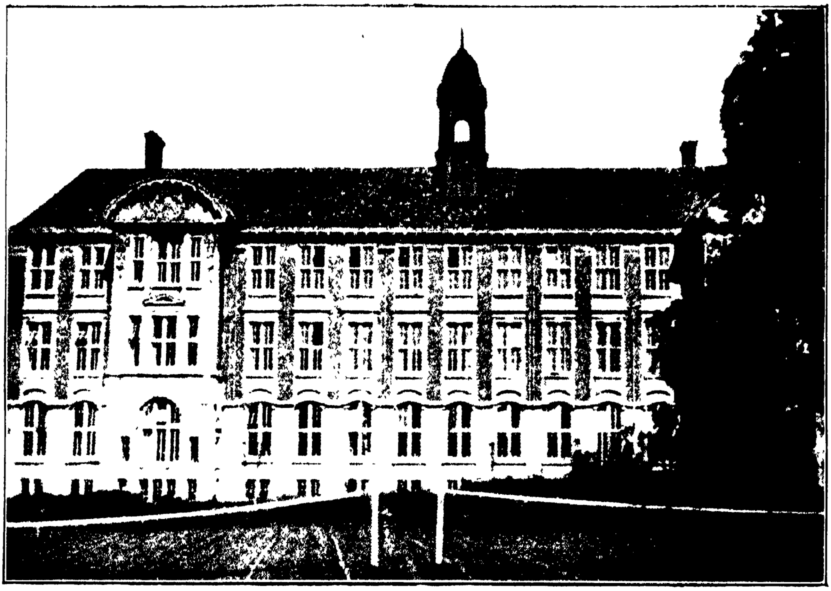

FIG. 1.—The School of Agriculture, South Front.

FIG. 2.—The Chemical Laboratory.

FIG. 3.—The Biological Laboratory.

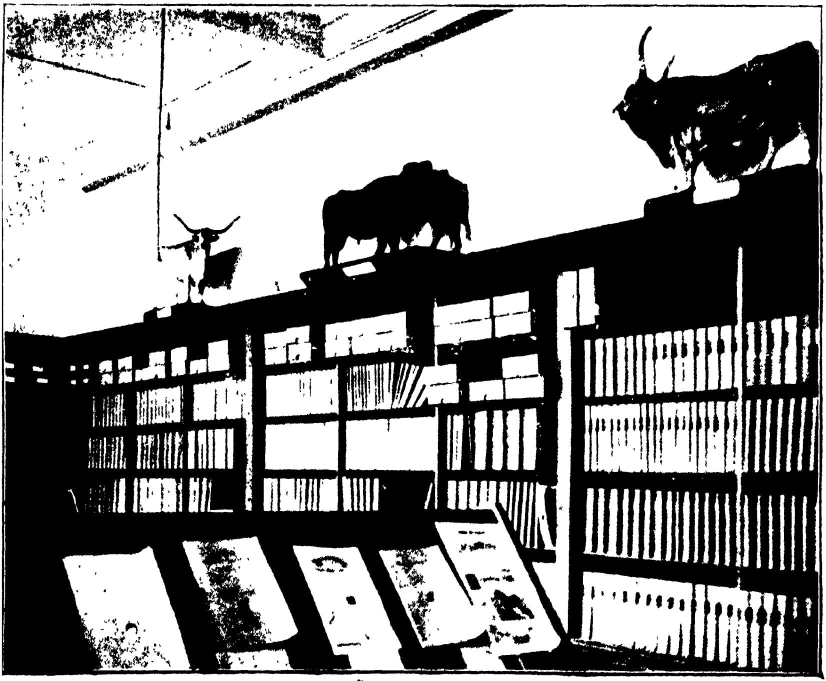

FIG. 4.—Part of the Library.

The course of instruction for the diploma extends over two years, with an examination at the end of each. The first examination for the diploma is a difficult technical examination in agriculture and agricultural sciences. In the second year a candidate may specialise in any line, either practical or scientific, and is examined in that line only. Thus, the diploma is a valuable qualification of professional standard. The University gives diplomas also in forestry and horticulture, the instruction and examination for which are on similar lines.

These diplomas are taken for the most part by Cambridge men who have already taken honours degrees in natural science and are intending to become agricultural experts at home or abroad. It is a point worth noting that in Cambridge over 300 men take honours degrees in science every year.

For many years it has been an honoured tradition in Cambridge that every teacher in the science schools should engage in research in his own subject. This tradition has been followed in the case of agriculture. Already in 1910, when the School of Agriculture was opened, members of the staff were well known by their publications. It is only necessary to mention Professor Biffen's work on plant breeding, which has produced Little Joss Wheat, and Dr. Marshall's work on the physiology of reproduction.

When the Development Fund became available for the promotion of research, and the Development Commissioners decided to establish Research Institutes in various branches of agricultural science two of these Institutes were placed at Cambridge—a Plant Breeding Institute under the direction of Professor Biffen, and an Animal Nutrition Institute under the joint direction of the writer and Dr. Marshall. The Plant Breeding Institute has its laboratories in the School of Agriculture. It is also equipped with bird-proof cages for the experimental culture of small plots and with greenhouses and sorting rooms. These are accommodated at Gravel Hill Farm. The larger plots for testing and growing on for seed are situated at How Hill Farm, a mile further out on the Huntingdon Road, opposite Girton College. The staff of the Institute have concentrated their attention chiefly on cereals and potatoes. Up to the present the main practical result of their work has been the production of the two wheats, Little Joss and Yeoman, which are too well known to require description. But perhaps the result which will in future prove still more valuable is Professor Biffen's discovery of the mode of inheritance of immunity to yellow rust

in wheat. This discovery demonstrates the practicability of breeding varieties of crops which resist the attacks of diseases, and opens up a wide field of investigation which promises very valuable results.

The labours of Professor Biffen and his colleagues and of plant breeders generally, will be lightened by the establishment of the National Institute of Agricultural Botany with its headquarters on the Huntingdon Road opposite the University Farm. This Institute manages the national seed testing station, but its main function is to take over, test, grow on, and distribute seed of new and improved varieties of all kinds of agricultural crops, returning to the breeder a fair proportion of the profit derived from their sale.

The Animal Nutrition Institute has investigated and is investigating a variety of problems concerned with meat production. Its earliest efforts were directed to the study of the composition and feeding value of home-grown fodders, and members of the staff have published numerous papers on mangolds, straws, and silage, the latter in collaboration with Mr. Amos. Another line of work has been the investigation of winter beef production, which has been attacked both statistically and experimentally. Many papers have been published, but the investigation is still incomplete.

Dr. Marshall and his colleagues have extended their work on the physiology of reproduction to many problems of meat production, for example, seedy cut in bacon, the effect of spaying on rate of growth, the factors controlling the size of the litter in sows.

Mr. Mackenzie and his colleagues have made a special study of pig feeding under modern conditions, and have demonstrated the importance of vitamines and the value of palm kernel cake in pig feeding. Besides these more immediately practical investigations, several members of the staff have been engaged in the study of fundamental scientific problems of nutrition and have obtained important results. Scientific work of this kind, although its results may have no direct bearing on agricultural practice for perhaps 20 or even 50 years, is none the less important for the progress of agriculture. Just as present-day farmers and consumers of farm produce are to-day reaping the reward of Lawes' and Gilbert's purely scientific work on manures carried out at Rothamsted more than 50 years ago, so we may confidently expect that farmers and consumers of the future will equally benefit from work now in progress which at first sight may appear

to have no direct practical bearing. As examples of the work of the Institute which falls in this category, Mr. Foreman and Dr. Woodman's investigations on the chemistry of the proteins, and Mr. Capstick's experiments with his recording animal calorimeter may be mentioned.

Like the Plant Breeding Institute, the Animal Nutrition Institute has its main laboratories in the School of Agriculture, and in these the fundamental scientific work is concentrated. Its more practical activities are somewhat inconveniently scattered. Mr. Mackenzie's pigs are kept at Gravel Hill Farm. The winter beef production and ensilage investigations are carried out chiefly at How Hill Farm. Dr. Marshall's animals are located mainly in temporary premises at the field laboratories, Milton Road, a new department of the University, which the Institute shares with the medical school, the Quick department of Biology and the Biochemical Department.

The School is also interested in the work on the breeding of small animals, including poultry, in the department of genetics under Professor Punnett. The headquarters of this department adjoin Gravel Hill Farm, and are about to be considerably extended.

Besides the organised work of these Institutes, members of the staff of the School have carried out many independent investigations. Mr. Newman for many years has been engaged on a survey of the soils and agriculture of the eastern counties. Intensive surveys of certain areas have been published already, but the extensive general survey was delayed by the war and is now held up for lack of funds. It is impossible to refer specifically to the work of every member of so large a staff. It must suffice to say that every one maintains the tradition of doing his best to extend the boundaries of knowledge in his own subjects.

Before leaving this subject, it should be mentioned that certain officers of the School took a prominent part in the foundation of the *Journal of Agricultural Science*, which was first published by the University Press in 1905 and has since then formed the chief organ for the publication of the results of agricultural research in this country. This journal has undoubtedly played a very important part in the development throughout the country of an active band of research workers. It was started at the joint financial risk of the Editors and the University Press. During the war financial difficulties arose and it is now the joint property of the Research Institutes at Cambridge and Rothamsted and is edited by the Directors of those Institutes.

The School is recognised by the Ministry of Agriculture as the central institution for education and research in the eastern counties, and in this capacity it has received since 1912 an annual grant from the Ministry for the maintenance of an Advisory Department. The staff of this Department includes Mr. F. R. Petherbridge as biologist, Mr. W. S. Mansfield as agricultural chemist and Mr. Codling as analyst. Mr. Petherbridge and Mr. Mansfield spend a large proportion of their time in the country giving advice to farmers on all kinds of agricultural problems, usually through the county organisers.

The School of Agriculture at present has no endowment for agricultural scholarships or studentships. Among its pupils, however, are many holders of scholarships or studentships of one or other of the Cambridge Colleges which devote part of their endowments to the encouragement of all branches of learning, including the sciences allied to agriculture. The School is also one of the Institutions at which the research scholarships and training scholarships of the Ministry and the agricultural scholarships of the County Councils are tenable. Holders of scholarships of the various categories mentioned above have been among the best students attending the School and the present staff has been largely recruited from them.

The School in its degree courses aims at providing a liberal education for men who wish to spend their lives on the land in any capacity. Its Diploma courses are designed to go further and to give technical instruction of professional standard to post graduates who wish to practice as experts in some branch of agriculture, forestry, horticulture or the allied sciences.

The internal affairs of the School are managed by the Special Board for Agriculture and Forestry which is practically the Executive Committee of a larger body—the Board of Agricultural Studies. This latter body comprises University and County Council members and acts as a permanent agricultural conference for East Anglia.

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PRODUCTION OF MEAT ON PASTURES OF DIFFERENT TYPES.

SIR THOMAS MIDDLETON, K.B.E., C.B., LL.D.,
Development Commissioner.

IN this *Journal* for September, 1915, in a paper on "Systems of Farming and the production of Food," I made a brief reference to the production of meat on pastures of three different types. In the present paper I propose dealing with the same subject in more detail. The estimate then made of the yield from rich pastures has since been supplemented by the estimates of others; and I have also secured some additional figures, bearing on the production of food by poor pastures.

Rich Fattening Pastures.—The former estimate was based on the probable production of the best pastures in the English Midlands that I had had an opportunity of examining carefully. It may be recalled that the yield of this type of pasture was put at 190 lb. meat per acre in an average season, without any assistance from feeding stuffs. The total was made up as follows:—90-100 days' summer grazing, 200 lb. live weight increase, equivalent to 120 lb. fat meat; 70 days' autumn grazing, 100 lb. live weight increase, or 55 lb. moderately fat meat; late autumn and winter grazing for store cattle or sheep—30 lb. live weight increase, or 15 lb. lean meat. There would, necessarily, be wide departures from these figures in very good or very bad seasons, but I expressed the view that on the average of a term of years the output of the best pastures could not be expected to exceed the figures given.

With the object of ascertaining whether the particular grass land then in view was representative of the best in its particular locality, and also for the purpose of checking the estimates, I applied, in the autumn of 1920, through a mutual friend, to several experienced graziers in the locality, submitting to each the following questions:—

Assuming a *ten-acre* field of grass of first-rate quality, and *no feeding stuffs of any kind* to be used:—

1. What number of fattening cattle would the field carry during the summer months and what would be the average gain in live weight per head?

2. Assuming the first lot of cattle to be cleared off in July and the pasture to be rested, what number of cattle would be carried in the autumn months? Could these be fattened without cake in an average season? What increase per head might be expected in this lot of cattle if no artificial feeding stuffs were used?

3. Would sheep be grazed in addition to cattle in the summer or autumn months? If so, what number and what increase in weight per head would be expected?

4. Would the field carry any stock during the winter months? If so, what class of stock and what numbers?

Seven replies to this schedule of questions were returned. As the inquiry was made through private channels I shall not refer to the correspondents by name, but take this opportunity of acknowledging my indebtedness to them for the care they took in supplying full answers to the questions, and for explaining the particulars in which their own practice did not fit in exactly with the conditions assumed in the questions.

The correspondents were asked to provide estimates of the live increase that would be made by grazing animals and this they did. I am responsible for estimating the quantity of meat which these live weight gains should represent, and in changing from live to carcass increase the percentages used in my original paper have been adhered to. In this connection it may be noted that there is very little evidence available as to the probable percentage of carcass to live gain in the case of bullocks fattened on grass; and, from the percentage of carcass which such cattle yield when slaughtered, some may be disposed to consider that my figure of 60 per cent. for summer increase is too high; it should be observed therefore that the cattle fed on these rich pastures are in very good condition when they are turned out to grass, and that the subsequent live increase represents a much higher percentage of carcass than it would in the case of lean stores.

Reduced to figures the seven estimates were as follows:—

TABLE I.

	Total Live Increase, lb. per acre.	*Carcass Increase, lb. per acre.*
A	372	217
B	340	198
C	310	183
D	297	172
E	280	162
F	271	155
G	263	154
Average A—G	**305**	**177**
Do. A—D	330	192
Do. D—G	278	161
Original Estimate ...	**330**	**190**

The average of all seven estimates works out at 305 lb. live increase per acre, equivalent to about 177 lb. of meat; the

average of the first four—which may be taken as representing the best that can be expected—coincides with my original estimate, while the average of the last four, representing moderate returns from pastures of fine quality, is 16 per cent. less than was estimated.

My original figure for the quantity of beef produced during summer grazing was 120 lb. from 200 lb. live weight increase; the average of the seven estimates A to G works out at 113 lb. from 189 lb. live increase; the average of the four highest at 131 lb. from 218 lb. live increase.

Neglecting the value of the winter grazing, the average of the seven estimates for summer and autumn production works out at 172 lb. of meat from 295 lb. live increase, as against my original estimate of 175 lb. from 300 lb. live increase.

We may take it then that the best pastures in the English Midlands are capable of producing on an average of years about 175 lb. of meat per acre during the summer and autumn without the aid of feeding stuffs, and that if we add the increase from occasional grazing at other seasons of the year, the total production will amount to about 190 lb. of meat, and the total live increase to about 330 lb. per acre.

It is at once obvious how greatly the production of this rich grass land must exceed the average yield of our fattening pastures. The total number of grass-fed cattle marketed annually, from July to November inclusive, is about one million; feeding stuffs are freely used in fattening cattle on grass; but if even one-thirtieth part of the grass-land of the United Kingdom were equal in quality to these Midland pastures, all the beef made in the final fattening period by the home-fed cattle slaughtered from 1st July to 30th November could be produced on this small fraction of our grass land, without recourse to feeding stuffs and without any assistance from roots or other tillage crops.

From the actual numbers of the live stock marketed, it would, indeed, appear to be very unlikely that we could find 250,000 acres of grass land in the whole country capable of producing as much meat as those pastures which are here referred to. There is no doubt a very much larger area capable of producing this quantity of meat in a favourable season, but the particular quality which marks off a very fine from an ordinary good pasture is the certainty of the yield. It is only on the finest grass land that we can rely on securing high production on an average of years without aid from feeding stuffs.

Production on the Poorest Pastures.—Turning to the other end of the scale it may be asked what quantity of meat (or rather of carcass increase, for they do not produce the finished product) our poorest pastures are capable of furnishing on the average of a term of years? In my paper of September, 1915, I referred briefly to some of the manure and mutton experiments, with which Professor Somerville's name is associated, and without discussing the subject, took the figure of 20 lb. meat per acre as being sufficiently near the annual production for my then purpose. But if attention is directed to the yield of the poorest cultivated pastures this figure is, in fact, too high. The yield is likely to vary from about 12 lb. of lean meat in a poor grazing season to 20 lb. in a good season, and 16 lb. per acre represents the best average that can be expected from the poorest of these clay soil pastures, on which the use of basic slag produces so wonderful an improvement. Some figures in support of this view will now be examined.

TABLE II.

Increase in live weight of sheep grazing very poor pastures in five English counties.

County.	*Station.*	*Period.*	*Average Season's Increase per acre.* lb.
Northamptonshire	Cransley	1901–08	44
Cambridgeshire	East Hatley	1900–04	53
Essex	Great Yeldham	1901–03	30
Suffolk	Saxmundham	1905–15	75
Northumberland	Cockle Park	1897–1905	37
Do.	Do.	1906–14	22
Do.	Do.	1915–20	31
Do.	Do.	1897–1920	29

The live weight increase of sheep grazing very poor clay soil pastures is shown in Table II. The periods to which the figures for increase refer are indicated. The influence of a series of good grazing years is brought out by comparing the increase on the same land at Cockle Park for the periods 1906-14 and 1915-20. Although there is some evidence to show that this very poor grass deteriorates slowly under continuous sheep-grazing, it can still respond to very favourable weather and in 1920 there was the surprising increase of 54 lb. per acre on the unimproved land at Cockle Park.

It will be seen from the last column in Table II that of the pastures tested in five counties the grass on the Northumberland farm was the poorest, and as the records in this case are the most

complete we may concentrate attention on it, remarking only that although the actual experimental fields selected in Cambridgeshire, Northamptonshire and Essex were somewhat better than that in Northumberland, there would be little difficulty in matching the poverty of the Cockle Park pastures in most English counties. No statistics indicating the area of land equally poor are available, but the total amount of this poor grass must be at least ten times as great as the area of the very rich pastures to which reference has been made above.

Over a period of twenty-four years, including some very bad and some very good grazing seasons, the sheep on the unimproved land at Cockle Park made gains which average 29 lb. per acre per annum. But what does this increase in the living animal represent in the form of meat? This is a point to which little attention has been directed. It is often assumed that from 48 to 50 per cent. of the increase made by sheep of the class used in these experiments, would consist of carcass. In my opinion the proportion on very poor grazings is very much less.

In an experiment reported by me in 1902* it was shown that in 1901, a bad grazing season, the carcass increase of the best animals on improved land at Cockle Park was equal to 42.6 per cent. of the live weight gain. In 1902 a more extended experiment on the same lines was arranged and certain figures relating to the sheep of that season will be found on page 9 of the Seventh Report on the work at Cockle Park; but as my own connection with the Northumberland Station terminated before the end of the grazing season, the special point now in question was not discussed at the time. Through the courtesy of Professor Gilchrist and the Record Keeper at Cockle Park I have obtained the original figures relating to the sheep of 1902, and will now refer to those results of this old experiment which bear directly on the subject of carcass increase.

It may first be recalled that the grazing season of 1902 was a good one, a marked contrast to its predecessor; on the unimproved land sheep produced 41 lb. live increase per acre as against 23 lb. in 1901. At the end of the year the quality of the sheep grazing on the improved land was favourably reported on by the butcher.

On 20th May, when the experiment began, four typical sheep were selected, and after fasting for 15 hours were weighed and then slaughtered. The live and carcass weights (in brackets) of

* Sixth Annual Report on Experiments with Crops and Stock at the County Demonstration Farm, Cockle Park, Morpeth, p. 34.

the four were, 89 lb. (39 lb.), 80 lb. (35 lb.), 74 lb. (29 lb), 69 lb. (29 lb.). The percentage of carcass in the best sheep was nearly 44, in the poorest, just over 39. The average yield of carcass was 42.3 per cent. The sheep had not been shorn when killed. If slaughtered after clipping the percentage of carcass would have been 46. From sheep with early October fleeces about 44 per cent. of mutton would have been got.

On 8th October at the end of the grazing season, eighteen of the best sheep were selected from the six lots (out of eleven lots under experiment) which could produce three, or more than three, sheep fit for the butcher, and after 15 hours fast were weighed and killed. For one of the eighteen, full figures are not available; a second, the average sheep of the remaining seventeen, may be left out of account; particulars of the others, arranged in four groups, Lot I. those giving the highest, and Lot IV those giving the lowest percentage of mutton to live weight gain, are given in Table III. Lot A refers to the four sheep killed on 20th May.

TABLE III.

Lot.	Weight, *Live.* lb.	20th May. *Carcass.* lb.	Weight, *Live.* lb.	8th Oct. *Carcass.* lb.	Increase. *Live.* lb.	*Carcass.* lb.	Percentage of Carcass in Live Increase.
A	78	33	—	—	—	—	42
I	78	33	121	59	50	26	52
II	81	34	125	59	51	25	49
III	82	35	124	57	50	22	45
IV	78	33	119	52	47	19	41

With reference to these figures it should be noted that the carcass weights of Lots I to IV on 20th May have been estimated at 42.3 per cent. of the live weight, and that to the figures for live weight increase an addition has been made for the wool removed from each sheep in the first month of the grazing season.

The highest percentage of carcass to live increase given by any one sheep was 55 and the lowest 40.

As contrasted with the slaughtered animals, all of which were in a thriving state on 8th October, the remaining sheep on the unimproved pasture were in very lean condition, and in the butcher's judgment were losing weight; if they had been slaughtered it is not possible that even in the good grazing season of 1902, they would have shown nearly as much as 40 per cent. of carcass; comparing them with the animals selected for slaughter it may be estimated that the percentage of carcass to live increase could not have exceeded 35 or 36. None of the very lean sheep grazed on the unimproved land at Cockle Park

have been slaughtered during the twenty-five seasons for which records are now available; but if figures were available, I am satisfied that the 29 lb. of live increase credited to this grass land in Table II would be found to represent not more than 10 or 12 lb. per acre of carcass increase.

On the other hand when using these experimental figures for the purpose of estimating the yield of meat on our poorest cultivated grazings, it must be remembered that it is very unlikely that the full returns of which such pastures are capable can be obtained by grazing with sheep alone. If store cattle were kept along with sheep a greater increase would almost certainly be secured. It is possible, though not likely, that mixed grazing might increase the output by as much as 50 per cent. If we adopt this figure as a maximum, the average yield of meat by our poorest pastures may be estimated at from 15 to 16 lb. per acre, rising to 20 lb. in good grazing seasons and falling to 12 lb. in poor years.

Production on Grazing Land of Medium Quality.--In my original paper particulars were given of the yield secured at Cockle Park from two ten-acre fields, originally of the very poor quality of the grass-land above referred to, which had been greatly improved as a result of treatment with basic slag. From the figures then available I estimated the yield on the improved land at about 210 lb. live increase and 105 lb. of meat. Several good grazing seasons between 1914 and 1920 have slightly raised the average yield; over the fifteen year period 1906-1920 the figure for the live weight gain has been increased to 215 lb. On the other hand the carcass increase for both sheep and cattle was, in 1915, assumed at 50 per cent. of the live increase, and in view of the above figures for sheep this percentage is too high; the original estimate of 105 lb. meat per acre may therefore be retained for these particular fields.

The effects of good or bad grazing seasons on land of this type are illustrated by the records of these experimental fields. Averaging the results on the two ten acre enclosures, the following were the live weight yields per acre in the two best and two worst seasons experienced between 1906 and 1920. The figures refer to the summer grazing only.

Season.	*Live Increase, lb. per acre.*	*Per-cent. Increase over* 1914.
1907	250	61
1920	240	55
1910	170	10
1914	152	—

While the influence on production of a good grazing season at Cockle Park is shown by these figures, it must not be assumed that they necessarily represent the gains made by the store stock of the country in good and bad years. The actual differences are much less than the 50 to 60 per cent. found in this case; for these experimental pastures are grazed so as to make the most of the herbage they grow, whereas in actual farm practice it is impossible to secure the full advantages of a first-rate year. We have not stock enough in the country to consume all that grows in a bountiful season, the numbers of our live stock being adjusted to the grazing available in average years.

These ten-acre fields were referred to in my 1915 paper as representing store pastures of ordinary quality; but it may be remarked that the actual yield secured from them is far in excess of the average yield of the grass land of the United Kingdom. From information collected in the course of the War it is estimated that the average yield of meat by all grass land (meadows and pastures) lies between 70 and 75 lb. per acre; for pastures only it is about 7 lb. less.

Scope for Improvement in our Grass Land.—The quantity of meat to be expected from the three types of pasture discussed above, and the low average production of the pastures of the United Kingdom, clearly point to the scope for improvement which our grazings offer; moreover, it is not in quantity only that differences occur in the meat output of rich and of poor land. There is a wide difference in the food value of the prime meat produced by the rich grazings of the English Midlands and the lean meat which forms the carcass increase of cattle and sheep grazing the poorest pastures. Weight for weight the former is worth from three to four times the latter as a source of energy. Thus if both quantity and quality be taken into account, the food value of the produce of an acre of rich grass may equal the food value of the produce of forty acres of the poorest cultivated grazings.

Methods of improving grass land have been fully dealt with in one of the Ministry's recent publications,* and will not be referred to here; but it may be observed that although it is beyond our skill to secure a forty-fold increase, by converting such grass land as that of Cockle Park into pastures having the quality of the rich Midland grazings, it is quite possible to

* Manuring of Pastures for Meat and Milk, by Professor Somerville. Ministry of Agriculture and Fisheries Miscellaneous Publication No. 30, price 6d. post free.

produce on poor clay soils, what may be described as a "colourable imitation" of a rich pasture during a part of the grazing season. On the average of a long term of years it has been shown that suitable manuring and careful grazing may increase the production of such poor land ten-fold, if both quantity and quality be taken into account; and favoured by good seasons, skilful management might even be rewarded by a greater return.

These are the possibilities of improvement offered by certain types of poor pastures on clay land. When we come to the question of the increase that could be expected over a wide area, and in the circumstances and conditions under which the average farmer works, we must be contented with a very different set of ratios. If instead of a ten-fold increase, the occupiers of inferior grazings added even ten per cent. to their output of store cattle and sheep they would do well. Incidentally, too, by remedying the grievances of those farmers who feed cattle in winter, and now complain of the shortage of "stores," they might terminate a current controversy.

* * * * * *

THE PLANNING AND CONSTRUCTION OF COW-SHEDS.

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THE increasing attention being given to the production of clean milk inevitably opens up the question of the modern planning and construction of cow-sheds, and the following article and illustrations may be found interesting to those who contemplate new buildings or the reconstruction of existing buildings in the near future.

The questions of planning to minimise labour in ministration and to maintain the health and cleanliness of stock are well understood, but nevertheless the larger proportion of cowsheds throughout the country are far from being ideal, either in arrangement, construction, or fittings.

It has been pointed out by Mr. Mackintosh of the National Institute for Research in Dairying in his article on "How to

produce clean milk," published in the April issue of this *Journal*, that:—

"It is desirable, however, to study this question from different points of view and to maintain a due sense of proportion. It is quite correct to say that clean milk of the highest standard can be produced under very primitive conditions, provided attention is given to the cleanliness of the utensils, the cow and the milker, but it may not be a practical proposition to attempt to maintain such a standard of cleanliness, day after day, summer and winter, without taking steps to improve the cowshed or the water supply, and thus lessen the expenditure of time and labour.

The point of view of the cowman or milkers must also be appreciated; if nothing is done by the master to prevent cows wading in filthy mud or lying down amongst manure, one must not be surprised if exhortations to greater cleanliness meet with little response from the men. On the other hand, through carelessness or ignorance as to proper methods, an ideal cowshed and dairy with a complete plant may turn out milk which soon goes sour."

This is a thoroughly commonsense argument based on an understanding of human nature, and it is the human factor which counts most of all in the production of clean milk.

Under the present conditions both of farming and building the main factor in construction will be the question of cost, and unfortunately the equipment of modern cow-houses has too often been carried out on far too lavish a scale. Money has been spent on non-essentials both in construction and fittings, without any corresponding advantages in cheap or clean production.

Obviously an effort should be made to obtain due balance of all the factors—arrangement, construction, fittings, and the human element—so that without needless expenditure upon building the workers may be led to take a pride and interest in their work under stimulating conditions conducive to cleanliness and efficiency.

Broadly speaking no attempt is here made to dogmatise, but rather to illustrate plans and a form of construction which it is believed would be found cheap and convenient, easy to erect and suitable for extension and standardisation.

Again to quote Mr. Mackintosh:—

"It is unnecessary to attempt to lay down any general rules beyond stating that there should be good light and ventilation, and stalls and floors so constructed that they will assist in keeping cows clean. Regulations as to ventilation, air space, and superficial area have little to do with clean milk production apart from their bearing on the health of the cows."

So far as general arrangement is concerned it may be said that if accommodation is required for more than 12 or 15 cows

the double standing is strongly advocated as being more suitable for extension, economical of labour, and relatively cheaper to construct.

Arable Dairy Farm, Hucknall.—The illustrations given (Fig. 1) are of the Experimental Arable Dairy Farm at Hucknall, Notts., built under the direction of the Ministry of Agriculture in 1921. Its purpose is to demonstrate the intensive production of milk from 30 acres of arable land, the conservation of food stuffs being largely effected by means of a silo.

Conditions.—The conditions laid down by the Dairy Branch of the Ministry included standings for 22 cows placed head to head, with a central feeding passage having a straight run from the mixing floor and silo. The double doors to the former for the delivery of green food, and the convenient position of the shoot from the silo are consequently the essence of the plan and secure the most economical means of service in time and labour. The original intention was to allow sufficient width in the feeding passage to enable a loaded cart to be drawn through in order to feed fresh-cut green fodder direct from cart to cow, but considerations of economy led to a reduction in width, the feeding passage being finally constructed 5 feet wide. Provision had to be made to allow for future extension to accommodate 10 more cows.

It was necessary to balance the cow-house accommodation with other essential farm buildings, such as stabling, boxes, cartshed, and piggeries, which with the open yard, complete the steading. The conservation of liquid manure by means of a large underground tank, suitably placed for convenient access, was also considered an essential feature of the scheme.

Construction.—The decision to have a shed with double standings necessitated a roof of wide span, and under the abnormal building conditions then obtaining it was obvious that special consideration must be given to simple and economical construction, with due regard to a minimum of expense in future maintenance. These conditions and the fact that it was intended to use American Yoke Ties and standard metal stall divisions, one to each cow, led to the use of timber of small scantling, rather than the employment of heavy roof timbers or steel trusses, with a clear span from wall to wall. Reference to the section in Fig. 1 shows that intermediate supports are used, facilitating the use of the metal divisions and the employment of light timber trusses. Those supports carrying the roof principals are consequently spaced at 10 ft. 6 in. centres allowing standings for

3 cows per bay on each side, and enabling future extensions to be carried out in sections with the minimum of expense. One advantage of this type of roof with internal supports is that the external containing walls can be reduced to a minimum thickness and constructed without the expense of intermediate piers under each roof principal.

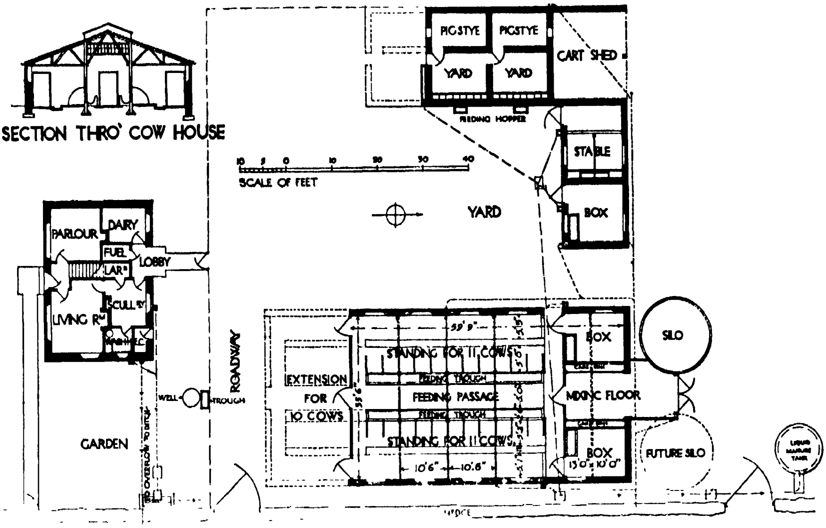
The trusses have double wood members for the rafters and tie beams with single ties and struts inserted between, all simply spiked through at the joints and all being formed from 4 in. × 1½ in. scantlings. The post supports are constructed of three 6 in. × 1½ in. pieces, stiffening the whole structure, and are so placed that they do not interfere with the working or accommodation of the building see Figs. 1 and 2. Incidentally the low tie beam over the dunging passages provides easy and convenient fixing for an overhead trolley should such be required for the removal of dung.

An important feature is the method of top lighting and ventilation, the centre of the roof over the feeding passage being raised at intervals for the purpose of inserting ventilating louvres and skylights, the tops of these raised portions being glazed. Galvanised iron sheets were used for the roof covering and thus all common rafters are eliminated, the sheets being spiked to purlins supported on the trusses at 10 ft. 6 in. centres.

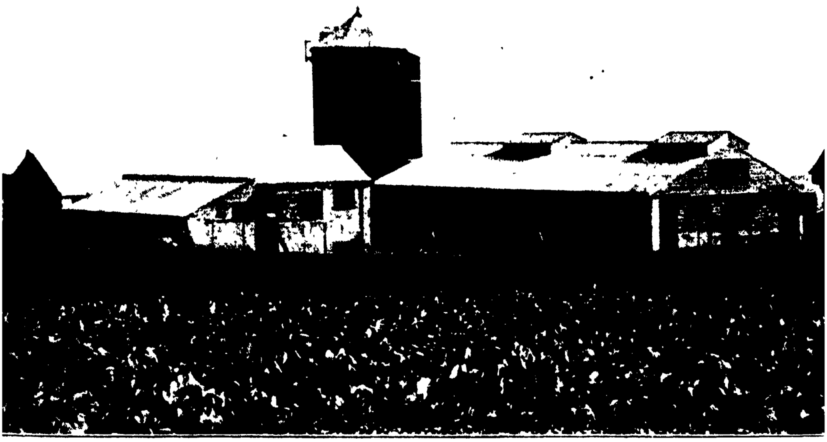
A light matchboard lining secured to the underside of the purlins prevents cold air and condensation from the iron roof descending upon the cows below. It will be noticed from the section that adequate stiffening is given by means of the cross braces, the whole roof being very rigid though formed of such small scantling timber.

Fittings and Details.—The doors are framed and braced, hung in two halves, and the windows are of the hopper type placed on each side for cross ventilation. As before stated the stall divisions are tubular and the American Yoke fitting is used for the ties. The use of these fittings enabled the cow standings to be reduced fully six inches in length and the width of the building is correspondingly reduced, an economy of space and material which partly compensates for the more expensive type of fitting.

The feeding troughs are of concrete, continuous from end to end, as the Yoke fittings restrict " poaching " to a minimum and thus cleaning out is facilitated and the expense of cross divisions in the mangers is avoided. The dung gutters are only

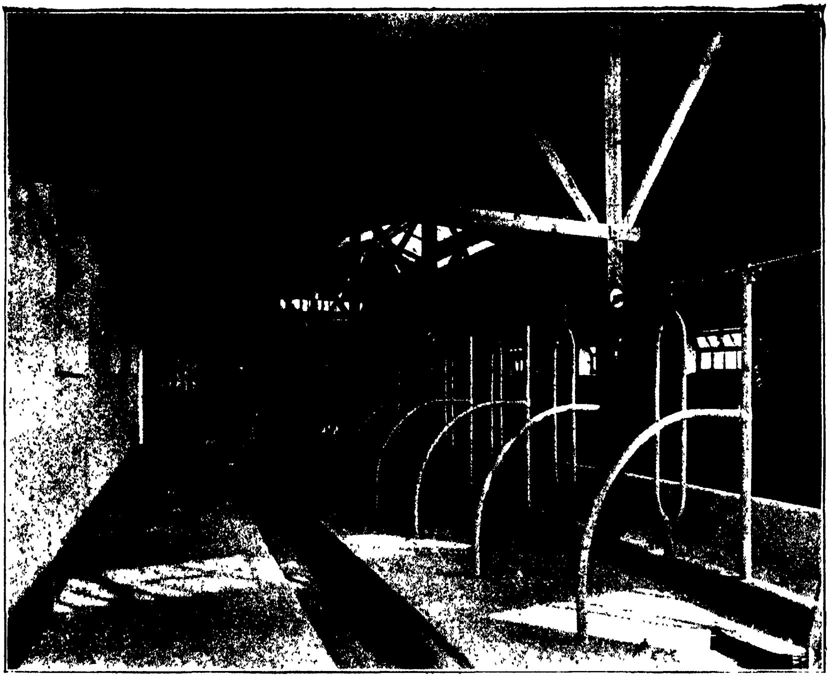


Plan.



General View from South-West.

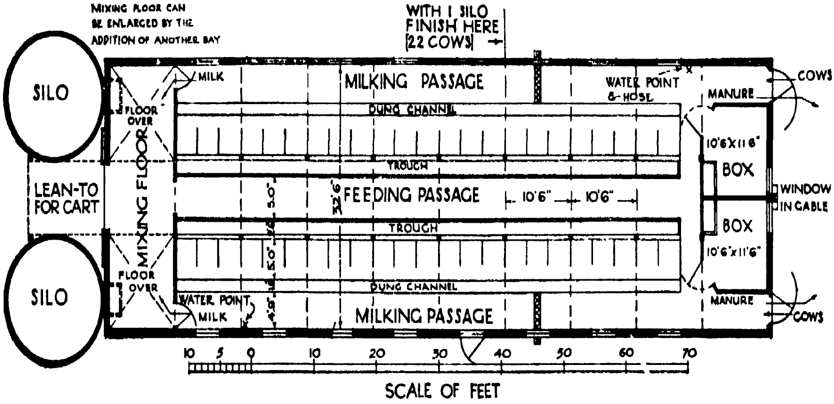
FIG. 1.—The Ministry's Arable Dairy Farm, Hucknall, Notts.



Interior View of Cow-house, showing Milking-Passage.

Interior View, showing Feeding Passage and Sky-lights.

FIG. 2.—The Ministry's Arable Dairy Farm, Hucknall, Notts.



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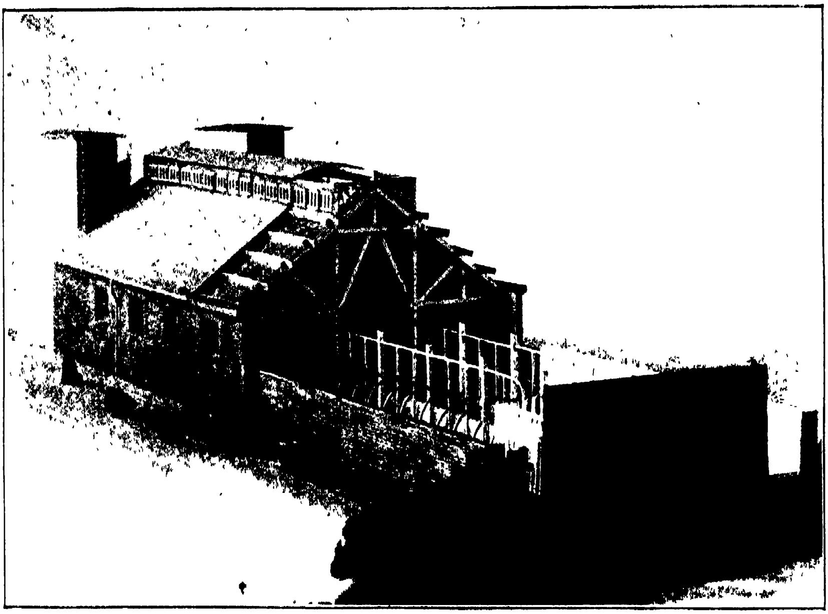
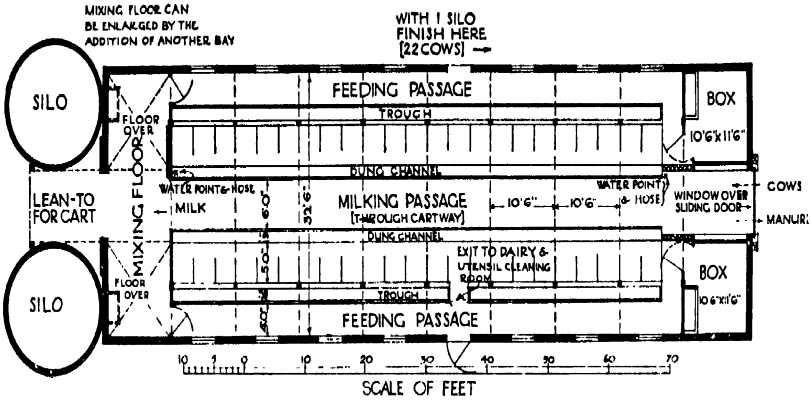
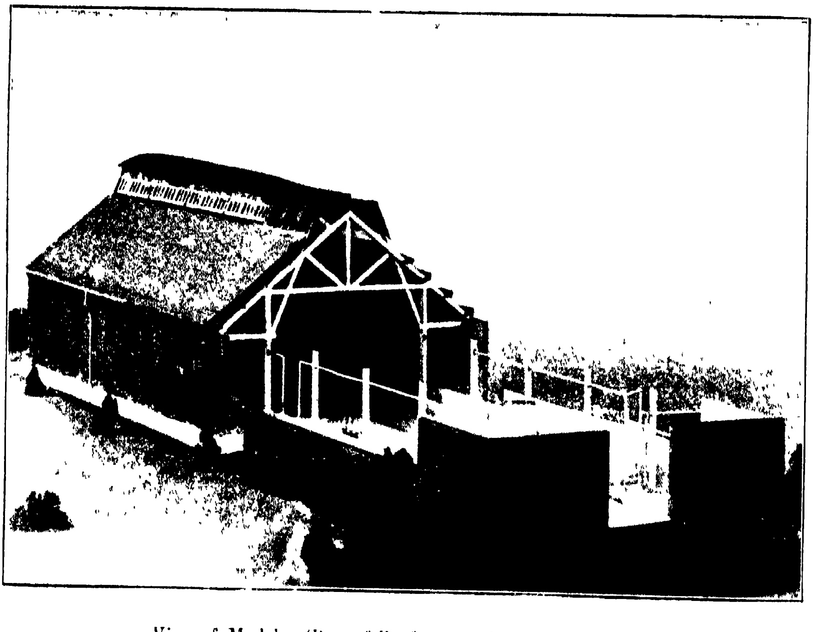


View of Model. (Part of Roof removed to show interior.)

FIG. 3.—Suggested development of Hucknall Cow-house for 40–50 cows, with head to head arrangement (Scheme A).



Plan.



View of Model. (Part of Roof removed to show interior.)

FIG. 4. Suggested development of Hucknall Cow-house for 40–50 cows, with tail to tail arrangement (Scheme B).

18 in. wide made with a four-inch drop from the gangways and a ten-inch drop from the standings, which are therefore raised 6 in. above the floor of the gangways.

It is found that the provision of the Yoke tie keeps the droppings just about within the limits of the gutter and the writer was particularly struck with the cleanliness of the cows, especially noticeable in the case of the larger cows, although the standing is 5 ft. 2 in. in length on one side and only 5 ft. on the other. The right width for the gutter is a debatable point but if continued observations show that 18 in. is effective instead of the 2 ft. often demanded it is obvious that in a double standing, a reduction of one foot in the width of the building is an effective saving which again assists in compensating for the extra cost of the fittings.

To obviate excessive falls within the depth of the gutters themselves or the provision of cross channels and extra outlets advantage was taken of a natural fall in the ground, the whole floor sloping slightly towards the mixing floor and in the direction of the manure tank. Few sites are absolutely level and if advantage can be taken of a natural slope it is both economical and conducive to efficiency to adopt this method rather than construct a level floor with increased depth in the gutters.

A Suggested Standard Cow-House.—While making no claims to any striking innovations, the Hucknall design certainly offers possibilities of further development along economical structural lines, and its practical success in economic service and cleanliness led to the suggestion that it might prove of service if the same principles of construction and arrangement were applied to a design for a shed to contain a larger herd of some 40 or 50 cows.

Two Schemes were therefore prepared by the Building Branch of the Ministry to show the comparative merits of both head to head and tail to tail planning, and advantage was taken of the practical experience gained at Hucknall to introduce various modifications in detail whereby improvement could be effected.

Diagrams and slides made from these designs were utilised in a course of lectures given to the various University Agricultural Departments in England and Wales last winter, and aroused so much interest that it was thought desirable to prepare a model of each type for exhibition at the Royal Agricultural Show at Cambridge in July. These models have been prepared by Mr. L. C. Powell in the Ministry's drawing office and are constructed

to a scale of half an inch to the foot. For the purpose of showing the construction and interior fittings more clearly only half of each model has been completed.

Plans and photos of the two models are here given in Fig. 3 (Scheme A), and Fig. 4 (Scheme B).

The merits and demerits of the head to head and tail to tail systems are so well known it is hardly necessary to recapitulate them, but it may be mentioned that where the herd is sufficiently large to require the services of two men there are certain advantages in the tail to tail method, in which case each man has the undivided use of a feeding passage, and can work independently of the other, while there must be less disturbance among the cattle when feeding is taking place. While it is realised that the special feeding conditions obtaining at Hucknall may not apply in all cases, and silos may not be required, the arrangement of the mixing floor at one end of the building is adhered to and is equally applicable to either method of arrangement. It has, however, been extended right across the building from wall to wall with storage floors over at each side which can be filled from a loaded cart standing in the centre gangway. The mixing floor shown on the plans is restricted to the width of one bay, but in practice it would probably be found necessary to increase this to two bays for a herd of 40 to 50 cows.

The silos, if required, can be discharged in convenient places and a lean-to is shown in Scheme A, where a cart-load of fodder may be placed over night or at the week end.

A comparison of the photographs shows that the tail to tail method, Scheme B, lends itself to a simpler and more efficacious system of construction, lighting and ventilation; even in the photographs of the models it is clear that this building is better lighted than the other, and it is a noteworthy fact that the roof requires one-third less timber, a material advantage in cost.

General Construction.—The Hucknall principle of construction has been adhered to, namely, the use of small scantling timber, but the pitch of the roof in both schemes has been made to suit slating or corrugated asbestos sheeting. The main variation has been made in the method of top lighting.

In both schemes a continuous clerestory has replaced the separated raised skylights of the Hucknall plan, thus admitting light with better distribution to the whole building. The two Schemes A and B vary somewhat from each other, the variation being due to the different type of roof truss used, this in turn being governed by the different arrangement of the stalls. In Scheme A

the supports being closer together and near the centre the continuous clerestory is placed vertically above the posts and has vertical lights on either side, a proportion of which would be made to open for ventilation and would be controlled from below, but casements would be required for the glazing, a material addition to the cost, and the controls are apt to get out of gear and cause trouble in adjustment.

In Scheme B the central dunging passage admits of the supports being placed nearer the side walls and by carrying up the braces, sloping sides are obtained to the clerestory which admit more light. Alternative suggestions are shown for the lighting and ventilation, viz., either fixed glazed casements, or reinforced glass secured direct to the framing by the same method as in greenhouse roofs. Allowance is made for expansion and contraction by means of galvanised clips, while provision would be made for the escape of condensation.

Ample ventilation is obtained by raising the curved corrugated iron or asbestos top of the clerestory two or three inches above the framing by means of blocks placed at intervals. This space is protected by close mesh wire to keep out birds and insures adequate cross ventilation above the flat ceiling of the clerestory.

To let out the hot and foul air rising from below it is suggested that this flat ceiling could be cheaply formed of battens spaced half an inch apart similar to Yorkshire space boarding and as it is continuous throughout the whole length of the shed the extraction of air would be so distributed as to obviate any possibility of draughts. An alternate method of ventilation panels is shown in the model, one in each roof bay, but the former method is considered by far the better and cheaper and likely to prove the more efficacious in actual working.

It is also suggested that as the top lighting in this scheme would be ample the openings in the side walls immediately in front of the cows should not be glazed but should be fitted with simple adjustable louvre shutters such as are commonly found in the midland counties. Thus fresh air would be admitted and the supply regulated in the feeding passage by means of the adjustable louvres, the openings in the clerestory acting entirely as outlets. The actual inlet ventilation area of the two louvres in each bay would approximately equal the outlet ventilation area between the spaced boarding in the flat ceiling.

It is seriously suggested that the provision of closely spaced louvres in the lower openings would overcome the great diffi-

culty experienced in well lighted cow houses of combating the nuisance of flies. It may not be generally known that in Italy it is possible to keep houses absolutely clear of flies provided the louvre shutters are not opened in the day time. The glazed casements within may stand wide open but flies do not enter unless the louvre casements are opened back as well.

It is admitted that this does not get over the fact that flies also come into the cow-house on the bodies of cows returning from pasture, but it would undoubtedly assist in minimising the nuisance.

In each scheme the total width of the buildings is the same, but in Scheme B, the tail to tail method, it is clear that not only is the construction less costly but it is claimed by the authors that the method of lighting and ventilation is more perfectly suited to the placing of the cows than in the head to head method.

It should be noted that the trusses throughout the whole length of the building are placed, as at Hucknall, at 10 ft. 6 in. centres, and each complete bay provides for 6 cows, admitting of easy extension if it is desired to commence with a smaller herd. In Model B the individual standings have not been shown but would be constructed in the same way as in Scheme A, viz., tubular stall divisions and Yoke ties.

In Scheme B provision is made in the centre of the building for a side entrance to enable milkers to pass quickly from all parts of the building to the dairy and utensil cleaning room which are considered essential and integral parts of a dairy homestead.

Cost and Cubical Contents.—It is difficult to give more than an indication of the probable cost of such buildings as are here illustrated, especially under present conditions, but the following facts may be some guide.

The total cubical content of the entire cowshed excluding the silos is approximately 54,500 cubic feet. Before the war such a shed as this could have been built at about 5d. per foot cube. It is not unreasonable at the present time to put building costs at twice the pre-war rate, say 10d. per foot cube for such work as this, which would give an approximate estimate of £2,227, say *£2,200*, for the complete building. Scheme B would certainly work out at a lower price.

These figures must only be regarded as a rough guide, as obviously there are differences in cost due to site, locality, local materials, etc. The main point is that owing to the character

of the design there should be no difficulty anywhere in obtaining the necessary materials, and there is nothing in the construction of the building demanding more skill than the average village builder has at his command.

In conclusion it should be noted that the air space is approximately 720 cubic feet per cow, a sufficiently ample allowance when the general conditions of the building are taken into consideration.

Space does not permit of the discussion of all the details, but it is hoped that the main essentials have been made clear and that the photographs and plans give a sufficient indication of the principles adopted and the methods of construction employed. Further it is hoped that the exhibition of the models at the various Agricultural Shows this summer will promote criticism and suggestions for improvement or modification of detail.

* * * * * *

LABOUR ORGANIZATION ON AN EAST MIDLANDS FARM.

PART I.

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FROM the point of view of the country as a whole it is highly desirable that all industries should be so organized as to give regular employment throughout the year to their workers. The agricultural industry—the greatest the country possesses—has been a noteworthy exception in the observation of this rule. In the days before machinery was a regular feature of farm equipment the seasonal demand for casual and part-time labour was very large, and though it is not now of so much importance, it is still a prominent feature of the industry in districts where specialised farming is in vogue, and it can easily be understood that unless this employment fits in with idle periods in other industries the worker himself, and the community at large, are bound to suffer. The farmer also loses by the system. The demand for casual labour comes when work which demands immediate attention cannot be overtaken by the

regularly employed hands. Casual labour must be obtained, and the general result is that high rates of wages have to be paid; and moreover a casual worker has not the same interest in the success of the farm as a regular employee, and the combination of high wages and indifferent work often results in costly labour. The farmer is also adversely affected in another way. The supply of skilled and reliable labour flowing to any industry is directly influenced by the regularity or otherwise of the employment offered. It is therefore not to be expected that men, at any rate the most enterprising and efficient of them, will remain in an industry where regular employment cannot be depended on. Speaking of general farming, which so greatly preponderates in this country, this casual labour problem is one which every farmer should endeavour to deal with as far as possible by looking ahead, and so organizing his farm as to ensure that the work at all seasons is more or less uniform and within the powers of the permanent labour. Agriculture is, however, in many respects like warfare—the enemy may upset the best laid plans. The weather, the friend of the agriculturist, is also his worst enemy, and on this account he requires a high standard of efficiency in management to overcome its vagaries.

Of course this question is largely bound up with the progress of invention in agricultural implements and machinery. Manual labour may be the only means of performing certain operations on the farm, and casual labour the most economical way of getting them carried out, but as far as possible, and consistently with getting the operations completed within a reasonable time, they should be accomplished by the permanent staff of the farm, stimulated, if need be, to greater effort by piece-work rates. Against piece-work it is said that the work is not well done, but so long as the farmer keeps a watchful eye on the men this argument against its adoption largely falls.

It is not intended in this paper to discuss the organization of labour under the various types of farming which exist in this country, but to illustrate a few aspects of the economics of farm management which are well worthy of study by all employers of agricultural labour. For this purpose the writer has selected a farm in the East Midlands, and examined the labour records kept for costing purposes from 1st June, 1918, to 31st May, 1919. The period 1st June to 31st May conforms to the accounting period on this farm.

The following statement shows the area of the farm, its crops and stock, the number of persons employed, their equivalents in

men, and the number of work-horses. The figures have been converted to a 100 acres basis for comparison, and the land and stock managing capacity of each man and the area worked by each pair of horses are shown at the foot of the statement.

	Total.		Per 100 acres.	
1. ACREAGE :—				
(a) *Arable*—				
Grain Crops	436		45·2	
Root and Fallow Crops ...	140		14·6	
Pulse	49		5·1	
Seeds for Hay	55		5·5	
Seeds not for Hay ...	85		8·9	
Other Crops	6		·6	
		771		79·9
(b) *Grass*—				
Hay	22		2·3	
Pasture	172		17·8	
		194		20·1
		965		100·
2. STOCK :—				
Cows and Heifers in milk and in calf	49		5·1	
Other Cattle—				
2 years and over	24		2·5	
1 year and under 2 ...	37		3·8	
Calves	73		7·6	
		183		19·0
Sheep—				
Ewes	264		27·4	
Shearlings	139		14·4	
Lambs	356		36·9	
		759		78·7
Pigs—				
Sows	11		1·1	
Others	109		11·3	
		120		12·4
Horses—				
Working		24		2·5
Others		12		1·2
3. PERSONS employed		28		2·9
Men equivalents...		24		2·5

	Acres of Arable.	Acres of Grass.	All Cattle.	All Sheep.	All Pigs.
Per man equivalent	32·09	8·07	7·62	31·62	5·00
Per pair of horses	64·25	16·16			

As will be seen nearly 80 per cent. of the total area is under arable cultivation. The soil is light in character and mostly capable of being worked by two-horse teams. The four-course system of cropping is adopted, with wheat and barley as the principal grain crops. The pasture is grazed by all classes of stock, and only twenty-two acres are made annually into hay. A dairy herd of 21 to 26 milking cows is maintained with a proportionate number of young stock. As the farm is a considerable distance from a railway station the produce of the dairy herd is

made into butter, the separated milk being available for the young stock and the pigs. All young stock are yarded in winter for the purpose of consuming the roots and straw, and to tread the remainder of the latter into manure for the land. The ewes run with their lambs on the pastures and grazing seeds during the summer, and are folded on roots during the winter, the tegs being fattened off and a sufficient number of ewe lambs retained to maintain the flock. As the table shows, a considerable number of pigs are kept. The open air system is not practised, the pigs being maintained wholly indoors and fed for the production of bacon.

The labour supply was regular, except at certain times, casual hands and gangs being employed during busy seasons on carrots and potatoes, but an average of nineteen men, four to five women, and four boys were regularly employed.

Manual Labour.—Fig. 1 showing the distribution of the manual labour on this farm for the year 1918-19, illustrates the nature of the demand for labour on the farm. If the work had been capable of being performed by full-time labour the height of the column in each month would have been alike, but bearing in mind the climatic conditions with which agriculture has to contend, and also the fact that during the War efficient labour was difficult to obtain, the results secured must be regarded as bearing witness to the high degree of skill on the part of the farmer. The maximum variation of employment month by month is 17 per cent., and omitting the busy periods of May, June, October and November, it is less than 10 per cent.

The graph has been split up for the purpose of illustration and discussion into the departments making demands for labour, viz.: (1) Arable; (2) Sheep; (3) Other Stock; (4) Pasture, and (5) Establishment.

(1) *Arable.*—The portion relating to the arable has been subdivided by a dotted line. The upper part shows the time spent in threshing, dressing, and the delivery of the various grain and pulse crops. The lower part combines all the labour on the field operations of ploughing, cultivating, manuring, sowing, harvesting, etc., of all the crops on the farm during the year.

(2) *Sheep.*—This includes the time of a fully-employed shepherd throughout the year, and also of additional assistance required by him when the sheep were being folded on roots, at lambing, and also at shearing and dipping times.

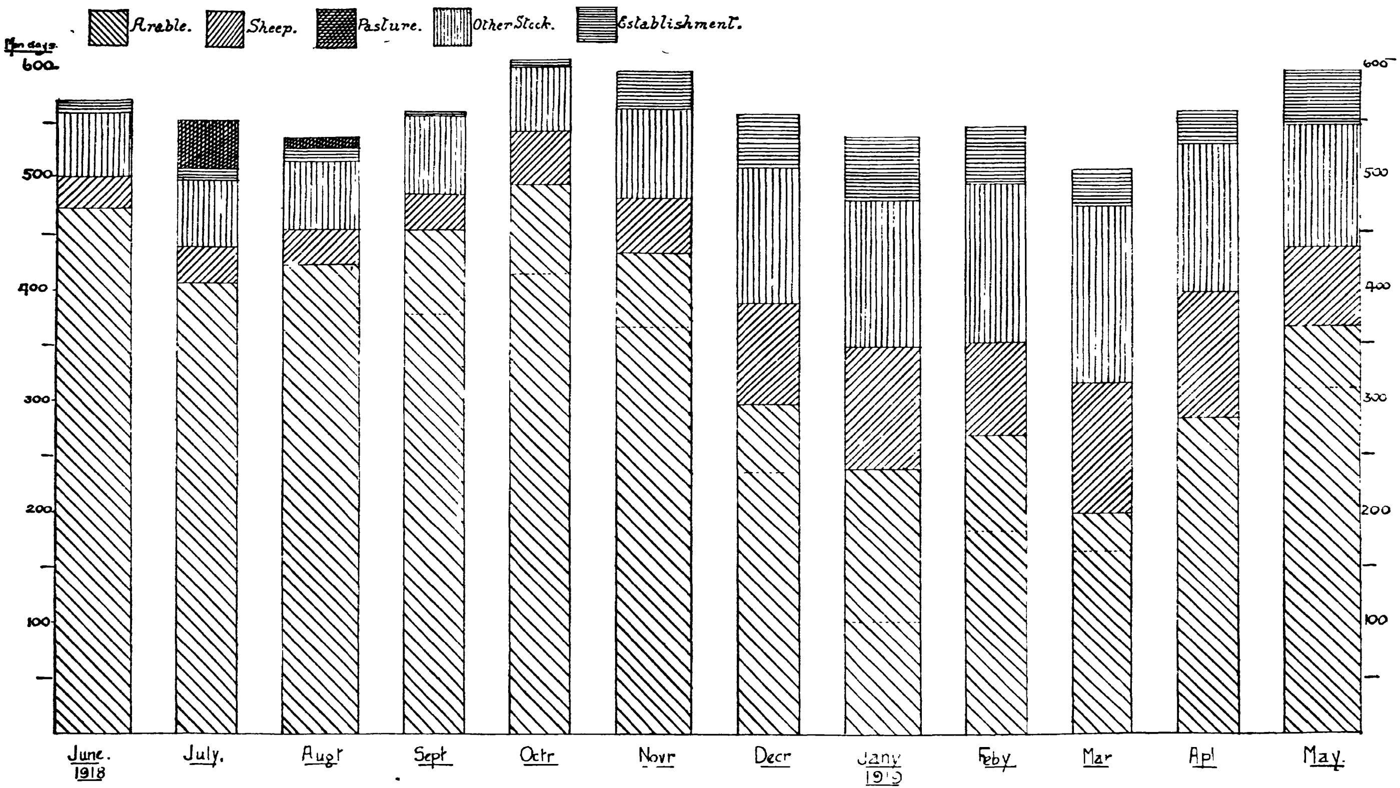

FIG. 1.—Distribution of Manual Labour 1918-1919.

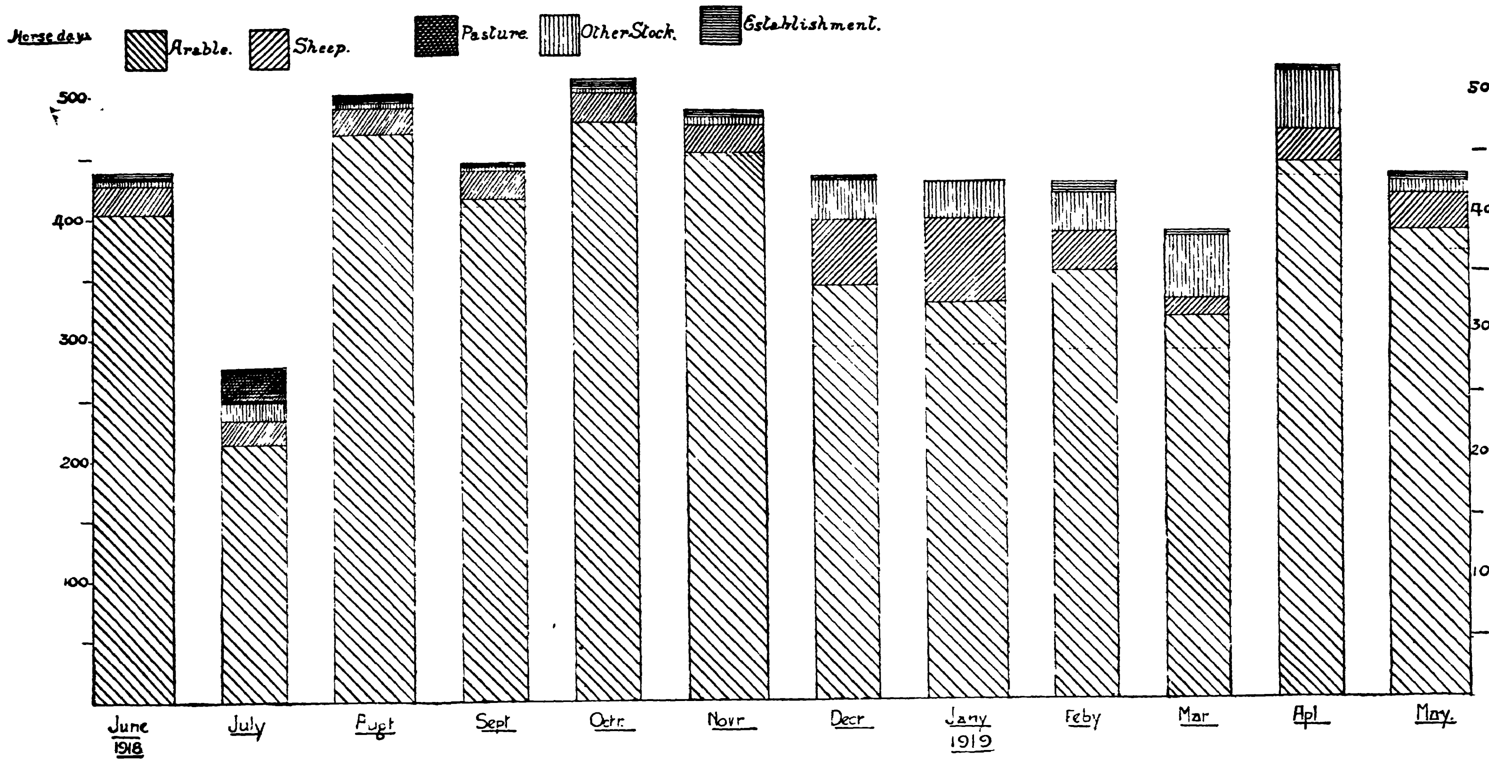

FIG. 2.—Distribution of Horse Labour 1918–1919.

(3) *Other Stock.*—This portion of the graph similarly includes all manual labour in feeding and milking, root carting, and other incidental work directly connected with all the stock on the farm, exclusive of the sheep. Owing to the interchangeable nature of the labour on the stock it was found impossible to divide this labour on any accurate basis between the dairy herd, other cattle, and the pigs.

(4) *Pasture.*—Manual labour in harrowing and rolling the pastures, any manurial operations, and the work involved at hay-making are the only items shown under this head.

(5) *Establishment.*—This portion covers all manual labour which cannot be *directly* charged to any of the productive departments of the farm. In cost accounting such terms as " overhead charges," " general expenses," signify payments for this class of work.

There are many operations on a farm which come under this head. Hedging, fencing, ditching, road repairs, and sundry other items, are examples of this class of work performed by the labour staff of the farm. An allocation of this work to the productive departments is possible, but as it plays an important part in labour organization, it was considered advisable to show it separately.

A misconception of the nature of establishment work is often observed in the minds of farmers and writers on agricultural topics. It is a commonplace to hear it spoken of as entirely unproductive work. It is possible to imagine a state of super-farming, where work of this category is accomplished to keep the farm in a " spick and span " condition without in any sense being productive, or where through lack of organization this work is done in conflict with productive work with the result that the men are idle at less busy periods, or again where, through indifferent work, it has to be done a second time. In this last case the first work was entirely unproductive. A familiar example is gap stopping. Improperly done in the first instance sheep or cattle break out again at the same place, and apart from the waste of time in getting the stock back the gap has again to be repaired, and the time spent in the first instance was of no avail.

But on the whole where the work is well executed establishment operations are conducive to the well-being of the crops and stock of the farm, and if they were left undone for any length of time the farm would suffer severely. The writer has a case in mind where, owing to the failure to clean out a water-course, the outfall of the drainage system was blocked up, with disastrous

results to the state of the fields adjoining. The term " indirectly productive " used by some American agricultural economists is therefore preferred as a definition of establishment work.

In a general way the graph shows the relative importance of the labour requirements of each line of production under this type of farming. Naturally the labour on the arable stands out prominently. What is more important to notice, and this is the main feature of the graph, is how the arable and the two stock departments fulfil the condition of equalizing the labour demands when the work, as here, is efficiently organized. During the busy months in the year on the land, on this farm—May, June, July, August, September, October and November—the stock are on grass and more or less shifting for themselves, thus reducing their labour requirements to a minimum, and the labour on sheep is also comparatively small, while during the winter months and early spring, when arable land operations are curtailed by weather conditions, etc., the labour required for all the classes of stock is considerably increased, and with the " granary " work—threshing, etc.—makes up for the diminished demand on the land. Further, winter is the period of the year when ditching, hedging, fencing, road repairs and other establishment works can be carried out without disturbing the essential work for crops and stock.

In organizing labour, therefore, the unit of organization is the farm itself, not its individual parts. Each line of production must be correlated and linked up with the others. Thus, the efficient manager of farm labour must not only consider the labour for his crop rotation, but what is equally imperative the relation of stock labour to that required for the crops, in order that he may supplement where necessary the work on the land, and so ensure a continuous demand on the labour at his disposal. The graph (Fig. 1) shows fairly conclusively that for this style of farming arable is dependent to a large extent on the stock to regulate the labour requirements.

To enable a farmer to organize labour effectively a thorough knowledge of crops and stock is essential. This phase of farm management is outside the scope of this article. A short discussion of the importance of doing work at the right time will not, however, be out of place. Certain classes of work must have preference over others at any given time. It will be at once recognized that the feeding of stock cannot be put off; the work at seed time and harvest, and the thinning of root crops are all operations which must be completed within a limited period of

time. On the other hand, operations such as ploughing can be spread over longer periods, but that this is not always so will be apparent in the busy period which follows harvest in the preparation of the land for winter corn. Operations of this class must not, however, be delayed so as to crowd the work into too short a period, and thus bring them into the class demanding immediate attention. If, for example, the ploughing of the land for barley be put off until the spring, then the work must be completed within a very limited period, with a corresponding strain on men, horses, and equipment.

On wet days, or where, owing to previous rain, the land is too wet to be worked, the horsemen and other workers in the fields will be affected. The farmer should therefore aim at having a programme of work in readiness in order that no delay should occur in its execution when the time arrives. Many tasks can be performed at these times. Barn-work, repairs to implements and harness, and other tasks are familiar examples of wet day work, and the carting of corn, and of coals for threshing, and also various forms of establishment work out of doors can be performed when the land is too wet to be worked.

The class of work grouped under the head of establishment—the indirectly productive work—should never have preference over productive work. If it can be shown that, owing to weather conditions, a farmer executed some establishment work in July of a given year, when at the same time the self-binder which he expected to use in a few weeks' time was out of repair, it can be readily seen that valuable time will be lost when the grain is ready for cutting.

In this country establishment work is *mainly* carried out during the winter months, when, as shown in the graph (Fig. 1), it plays an important part in the equal distribution of labour. The large quantity of this work which was carried out in March, April and May, on this farm is quite remarkable. The state of the weather may have been partly responsible, but without an accurate knowledge of the weather conditions at this period it cannot be stated whether this was so. Another possibility is that the farmer was anticipating his needs for additional labour in June and July on the root crops, and was possibly carrying a little more labour than he could employ on directly productive work at this time. In the whole year establishment work accounted for a little over 5 per cent. of the men's time.

A striking feature is the little work required for pasture land, which is another way of saying that it is not the pasture but the

stock it carries which makes the demand for labour; only in two months in the year—July and August—during haymaking was any work actually carried out on the grass. Neither harrowing or rolling appears to have been done in the spring of 1919.

A reiteration of the necessity for thorough organization is made here. Every farmer should think ahead and have a programme of the main work to be accomplished on his farm. It is not expected that farm work can altogether be carried out according to schedule, but a good programme will minimize errors and avoid delays. Greater efficiency in the management of the labour should result in obtaining a larger production from a given expenditure, for if men can be kept fully employed on directly productive work the unit cost of production must fall. One expedient of the inefficient manager, in order to reduce labour expenditure, is to get rid of some of the men, when there is little work to be accomplished, thus reducing them to part-time workers. The effect of this action on the farmer, worker, and society at large has already been discussed.

Horse Labour.—Graph No. 2 (Fig. 2) shows the distribution of the horse labour on this farm. The same sub-division has been adopted as in the manual labour graph. The actual number of working days per horse during the year was 243.4 or 77.8 per cent. of the total possible working days. The percentage of the possible working days in each month of the year was as follows:—

	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1918 ...	76·1	48·1	87·1	76·7	88·7	84·4	74·8
	Jan.	Feb.	March.	April.	May.		
1919 ...	73·9	73·7	66·6	90·0	74·6		

It must not be assumed, owing to the small percentage worked in certain months, that this farm was overstocked with work horses, or that the great irregularity shows inefficient management. It has already been demonstrated,* that similar results are obtained by taking the average of five farms of different types. The number of working horses which a farm requires is not determined by the average requirements over the year, but by the number necessary to overtake the work in the busiest months. Therefore, on this farm, although an extremely slack period occurs in July, and comparatively slack periods in June, December, January, February, March and May in the year under review, yet a sufficient number of horses must be retained in these months to accomplish the

* C. S. Orwin, Determination of Farming Costs, 2nd Edition, 1921.

work in the busy seasons. This rule is also applicable when there is a tractor on a farm, unless it can so overtake the work as to keep horse work uniform throughout the year. The test of practice only can show whether this can be done. Some evidence that tractors do not fulfil this condition nor displace horses equivalent to their potential capacity is given by Mr. A. G. Ruston.* He says: "In every case investigated by the writer one effect of the introduction of a tractor on a farm has been without exception to increase the cost of horse labour per working day, because, owing to the fact that at certain times of the year, such as hay-time and harvest, horses are absolutely essential, the introduction of a tractor is rarely accompanied by the selling-off of its equivalent of horses. In consequence there is a decrease in the number of working days per horse per year." This, however, is only one aspect of the various considerations which require investigation when introducing a tractor. The manual labour which a tractor can displace, the running costs and depreciation of the new equipment as compared with the old, the advantages of getting work done quickly and the influence on the yield of the crops, are all factors which require to be measured in order to gauge whether the combination of tractor power with horse power is an economical one.

Returning to the graph, it is well to notice how relatively unimportant are the demands which stock make on horse labour, though the sheep make a fairly steady demand. One horse was definitely allocated to the shepherd during this year for the carting of hay, concentrated foods, shifting of hurdles, etc., yet in December and January this horse was not capable of undertaking the whole of the carting work and the time of two horses in the former month, and nearly the whole time of three horses in the latter were required, principally for the carting of roots. The remainder of the stock only require the services of horses to any particular extent from December to April, again mainly due to the carting of roots when the stock are indoors. On a farm of this type, where the proportion of arable to grass is high, the stock work is mainly supplementary to that on the arable, and generally speaking, if provision is made for working the arable, the same horses will easily do the stock work in addition.

* A. G. Ruston. "The Cost of Horse Labour," Journal of the Ministry of Agriculture, Dec., 1921, p. 810.

On this farm the pasture, as in the case of manual labour, makes little demand for horse labour, and that only at hay time. There seems to be no reason why harrowing and rolling should not have been carried out in March, 1919, when both manual and horse labour graphs show a relatively slack period.

Establishment work requires very little horse labour, as would be expected. The proportion of horse time spent on this class of work was less than 1 per cent. as compared with 5 per cent. for that of manual labour.

One would expect a much higher percentage of days to be worked in June and July, in the height of summer, than is shown. The demand made by turnips for horse labour in these months was remarkable, and the whole of the root crops together required by far the greatest proportion of both manual and horse labour requirements in these two months. Root crops are expensive to grow it will be admitted, but when considered from the standpoint of the use of labour—both men and horses—when it would not be otherwise required, and also having regard to the fact that they are cleaning crops, the expenditure may be an extremely economical one. The substitution of forage crops for silage in place of roots must always be considered in relation to labour utilization, a point which many advocates of silage crops often fail to substantiate.

To account for the small number of horse days worked on the farm in June and July it may be argued that there is very little hay land. Meadow hay accounted for 22 acres only, but there were also 55 acres of mowing seeds, and together these make a considerable amount of horse work. The fact remains that apart from the turnips and the hay no other crop on the farm can be effectively dealt with by horses at this time of the year, or if horses are able to work on them, the ratio of horses to men is not an economical one. Only hand weeding can be carried out on the grain crops; the carrot crop of six acres required only manual labour for weeding and thinning; and the work on the mangolds mainly consists of hand and horse-hoeing, in the last of which the relation of horses to men is 1 to 1, not 2 or 3 to 1 as in the case of ploughing, cultivating, etc. That manual labour is relatively more important at this time of year is borne out from a comparison of the manual and horse labour graphs for these months.

The introduction of root thinners or bunchers, and other labour-saving devices on root crops would provide for a more

extended use of horses at this time of the year, and not only so, but they should also be the means of displacing a certain amount of manual labour and making it available for other work; especially is this desirable where a large amount of casual labour has to be employed at this season of the year.

Where a few mares are kept for breeding purposes a means of reducing the cost of the horse-labour is provided, as the birth of the foals and the subsequent period when they have to run with their mothers coincides with these slack months; the cost of the keep of the mares then becomes a charge on the foals and not on the other enterprises of the farm. Whether this is a profitable way of dealing with the problem is another question and depends largely on the demand for work horses.

The ideal of horse labour management is the same as for manual labour, viz., uniform employment throughout the year on productive work. It will be apparent from the graph that this is difficult to attain, but efficient organization, as far as the weather and other conditions affecting the use of horses will allow, through a well thought out programme of work will make an enormous difference in the proportion of idle days.

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USE OF ELECTRICITY AT GREATER FELCOURT FARM.

R. BORLASE MATTHEWS, A.M.Inst.C.E., M.I.E.E.

IN order to show the possibilities of the use of electricity in farm buildings the writer proposes to explain the extent to which he "takes his own medicine," on his farm of 600 acres at East Grinstead. This method will probably be more interesting at the moment, since the author has read two papers* which summarise very fully the work he has been carrying out during recent years.

* "Electro-Farming, or the Applications of Electricity to Agriculture," read on 30th March, 1922, before the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, S.W.1; also, "The Uses of Electric Power in Agriculture," on 3rd April, 1922, read before The Farmers' Club, 2, Whitehall Court, S.W.1; also, "Electro-Farming," published by the Electrical Development Association, Savoy Street, Strand, W.C.2, price 1s.

Although wide use is made of electricity on the author's farm, it is not yet employed to anything like the extent to which ultimately it will be. It is only after exhaustive investigation, both of methods and equipment, that new applications are introduced. As the whole object of applying electricity to farming is to reduce costs and increase profits, the commercial aspect of each development is very carefully considered beforehand. The actual results are carefully analysed by means of a very detailed application of the author's Auto-Countancy system.

As a result of such investigation, it has been shown beyond all doubt that electricity applied on correct lines to agriculture possesses economic advantages which no other source of power can offer.

Electric Lighting.—The use of electric light not only makes for cleanliness and convenience of working, but owing to the absence of flame, reduces fire risk, a matter of importance where such inflammable materials as hay and straw are concerned. Experience, however, has shown that besides these obvious advantages, electric lighting on the farm can actually be made a source of profit.

To take the simplest case, it has been found that by installing electric light in the poultry houses, and thereby increasing the hours of light during the winter months, an increase in the winter egg production of at least 10 per cent. can be secured. When it is considered that the cost of lighting is only about one penny per bird per annum it will be seen that the return due to this application of electricity is very great.

One interesting result of the installation of electric light in the author's cow byres is that the cost of the current (at 4d. per unit) is paid by the saving resulting from the prevention of milk spillage due to better lighting. Although but little work has yet been done on the subject, there is no doubt that electric lighting will ultimately play a very great part in bringing both animals and plants more quickly to maturity. Recent experience with lambs, and also with flowers, such as tulips, has been very promising.

Where electricity is used for increasing the hours of light, it can be switched on and off by means of very simple automatic devices, known as "time switches." Thus it is not necessary to increase the hours of work on the farm, in order to obtain the advantage of a longer feeding day. In fact, by the provision of suitable hoppers, which can be filled at convenient times during working hours, labour and inconvenience are actually reduced as compared with ordinary methods.

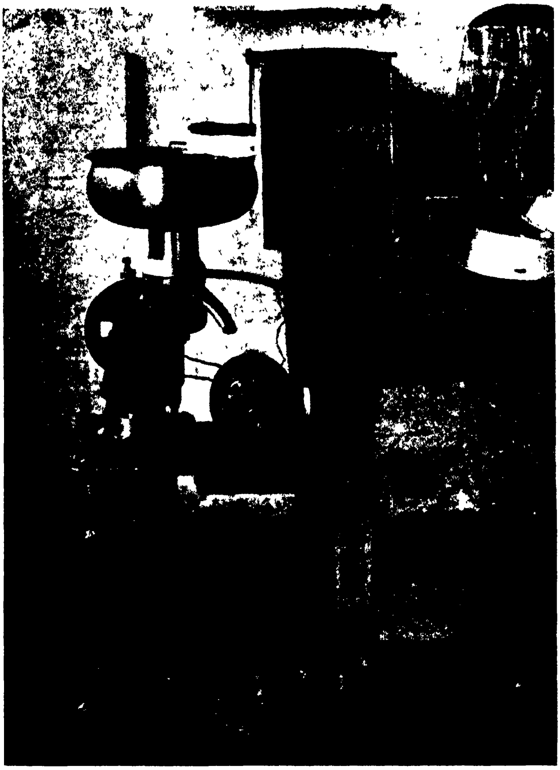

FIG. 1. An electrically-driven Cream Separator at Greater Felcourt Farm.

FIG. 2.—A combined Root Cleaner and Slicer at Greater Felcourt Farm.

It must not be supposed, however, that the mere provision of artificial light will give satisfactory results. What is required is "illumination." The same specialised experience and technical knowledge, which is required for the satisfactory illumination of a works, is required to obtain a satisfactory result even in the lighting of a poultry house.

Electric Power.—The advantages of electricity for power purposes have been found to be equally great. One of the most successful adaptations of electric power, on the author's farm, is for driving the liquid manure pump. By its aid, liquid manure carts are now quickly and cleanly filled, with the result that labour is better employed, and the land better treated. In the farm buildings electric power is used for driving the food-preparing machinery, as well as for milking. A special feature of the electric motor is its practically constant speed under varying loads, and its ability to deal with heavy overloads. It is, therefore, the ideal method of driving food-preparing machines such as chaff-cutters, cake-breakers, root-slicers, and crushing and grinding machines, all of which require a steady speed, irrespective of the wide fluctuations in the power which take place from second to second during operation.

The author's experience with electrically driven Hinman milking machines shows that by running the pumps at 42 pulsations per minute, instead of the higher speeds usually employed, the necessity for hand stripping is reduced (although some hand stripping is done in all cases). It should be noted that the milking machine does not milk quicker than by hand. As, however, one man can supervise six or more milking machines, the milking time is greatly reduced, so that both time and labour are saved. The cream separator, and a bottle-washing machine, are also driven by electric motors. The cardboard covers used to seal the bottles of Grade A (Certified) Milk, are hermetically attached by means of a specially designed electric heater, which enables 25 to 30 bottles to be sealed per minute.

Milk is delivered to the railway station, two miles distant, by an electric van. The cost of running has been found to be about one-halfpenny per mile, which compares most favourably with that of petrol lorries or horse vans.

Electric power is also used for driving the incubator fans, for the threshing, cleaning and grading of cereals, and for sheep-shearing and horse-clipping. Owing to the adequate supply of water under pressure which already exists, electric water pumping is not employed. On many farms, however, this would prove

a very useful and necessary application of electric power. The superiority of electricity for this purpose is well shown by the fact that in Denmark (which is a country of windmills) electric pumping is displacing wind pumping: the same thing is also happening in Holland. It is found that the electric motor is much more reliable, and pumps when it is needed to do so.

In order to show clearly what can be done for the expenditure of one unit* of electricity, in terms of farm work, the following table has been prepared, based upon results actually obtained on the author's farm. One unit of electricity will perform any one of the following operations:—

Operation.	*Average time taken.*
Chaff 1,000 lb. of hay or straw	10 min.
Cut 6 tons of mangolds	60 "
Crush 22 bushels of oats	25 "
Grind 3½ bushels of corn	5 "
Milk 52 cows	35 "
Separate 260 gal. of milk	—
Churn and work 165 lb. of butter	60 "
Drive the fans of a 2240 egg incubator for 15 hours	—
Thresh 8 bushels of wheat	11 "

One unit of electricity will do the work stated irrespective of the time taken. Average times are given merely to emphasise the added advantage of rapid working which results from the adoption of electrical methods.

Apart from the advantages referred to above, the ease with which the electric motor can be started makes it particularly valuable for farm work. By simply closing a switch, without any physical exertion, the motor will start instantly and with certainty under all conditions.

The author advocates the use of individual electric motors for the more important machines. Where this is not considered possible it will be found that the use of a portable electric motor (for which the author has devised a very cheap and simple arrangement) will be preferable to the use of counter-shafting. It is supposed by many that the use of a single motor and a counter-shaft gives the most economical results. This view, however, is quite mistaken. At Greater Felcourt Farm the food-preparing machinery is at present driven from a counter-shaft (originally installed for an oil engine drive) driven by the electric

* One unit is 1,000 watts expended for one hour. Watts represent the product of volts by amperes. Thus 10 amps. on a 100-volt circuit gives 1,000 watts, and if used for one hour means a consumption of one unit. Similarly, 60 amps. taken for 10 min., from a 100 volt circuit represents 1 unit because it is 6,000 watts used for ⅙ of an hour.

motor. Exact measurements (which of course are only possible where electricity is used) have proved that for every 6s. spent in useful work 5s. has to be wasted in useless effort merely in turning the shafting, belts, and loose pulleys. With electricity at 4d. per unit the yearly cost of the power wasted by the shafting is sufficient to buy a new electric motor of 3 to 4 h.p. capacity. Since the use of a counter-shaft increases the amount of current taken by one to four times that necessary for the useful load, the size of cables used in the wiring must be at least doubled. Again, if storage batteries are used to supply the load, their ampère-hour capacity must also be doubled. Not only is the cost of using electric power unnecessarily increased by the counter-shaft, but the capital cost of installing the plant is also much increased.

It is commonly supposed that the advantages of electricity can only be obtained by the large farmer, but the writer is convinced that this view is entirely wrong. While the big farmer uses electricity to supplement the efforts of his labourers, and thereby increase profits, the small-holder, who is usually unable to employ labour, stands in the greatest need of some simple means to increase his productive capacity. Electricity, properly applied, relieves the small-holder of much of the more monotonous work, leaving him free to concentrate on those things which require manual skill and knowledge. The first cost of the electrical equipment is not great. Its earning capacity is much greater than that of any other part of the farm equipment. Every year small-holders quite cheerfully pay large sums for new types of poultry houses and similar plant, in the hope of obtaining increased returns. It is very probable that by making their old houses weather-proof, and installing electric light, they would secure much greater returns at a much lower cost.

* * * * * *

WHEAT PRICES AND RAINFALL.

IT is obvious that crops are dependent upon the weather, and perhaps the most important question to which the farmer wants an answer is, " what will be the effect of the weather upon the harvest? " Of scarcely less importance to the farmer is the further question : "What is the weather going to be next year?" Students of the weather have for many years past been endeavouring, by analysis of past records, to find answers to these

questions, particularly by trying to find out whether abnormal temperature or rainfall recurs at regular intervals; *i.e.*, whether there is a regular sequence of weather, or *cycle*, as it is called.

Various astronomers and meteorologists have in recent years thus discovered cycles, some of which may now be regarded as well established. Of those that may conceivably produce a direct or indirect effect upon our crops the two best known are probably the sun-spot cycle and the Brückner cycle. It has for long been known that the number of spots occurring on the sun varies in a regular manner, a maximum and minimum occurring at intervals of about 11 years; also that certain terrestrial phenomena are influenced in the same way, indicating that sun-spots affect the conditions on the earth, or perhaps it should be said that both are due to the same cause. Dr. Brückner found some thirty years ago that a period of relatively warm and dry years recurred on the Continent about every 35 years, and similarly that the intervening years tended to be wet and cold. Although we are altogether in the dark as to the causes of such fluctuations in the weather, their influence must nevertheless make itself felt upon the growth of vegetation, and thus it becomes a very important matter to detect them.

It is conceivable that the weather of different parts of the earth may be differently affected by a large number of cycles, each of them due, maybe, to different causes. This makes it exceedingly difficult to discover any regular sequence in the weather or in the produce of agriculture by mere inspection of records. Since the periods of these cycles are not of the same duration, their beneficial or harmful influence does not recur at the same moment of time: it will thus happen that the maximum effect of one cycle will sometimes coincide with an opposite effect of some of the other cycles, and so its effect may be nullified. It is therefore only when the maximum or minimum effects of several influential cycles coincide in point of time, that their combined result will show itself in a big crop or severe shortage; and this can only be expected to recur at comparatively long intervals. Agricultural records have not been kept for a sufficient number of years to exhibit a sequence of good or bad harvests that can be relied on as a guide to the future, as an event known to have recurred only three or four times cannot be accepted as sufficient evidence of a regular cycle.

There is, however, one class of observations that is sufficiently long to be of use for this purpose, and that is the price of wheat,

of which records exist, in more or less complete form, for nearly 400 years, for a large number of places in western Europe. Now it is well known that, at least before the development of an overseas trade in corn, the price at a given locality was high when the harvest in that neighbourhood was scanty, and low when the crop was abundant. Sir William Beveridge has examined these data, and being struck by the appearance at regular intervals of abnormally high prices—which may be assumed to follow immediately on bad harvests—has conducted an exhaustive investigation into the whole material.*

Now although it is simple enough to combine several cycles to form, so to speak, one compound cycle, and find out when their cumulative influence is greatest or least, it is not so easy to decompose the resultant compound cycle, which is all that we have to work upon. Yet there are mathematical processes which enable us to unravel the threads and disentangle the constituent cycles. The arithmetical calculations are very heavy, but by the use of methods known as "harmonic analysis" and the "periodogram," Sir William Beveridge has succeeded in detecting a large number of cycles. He finds, in fact, no less than 19 (possibly there may be more), with periods of revolution ranging from 2¾ to 68 years. The probability of their real existence is in a large number of cases confirmed by the periods agreeing, with quite reasonable accuracy, with cycles detected by various meteorologists.

The most striking of these cycles, *i.e.*, the one emerging most prominently from the calculations, is one of about 15 years; and it is the more remarkable because an independent period of this duration is not known to meteorologists. Sir William Beveridge suggests, however, that it may be really a combination of shorter cycles, the maximum intensity of all of which would coincide about every fifteenth or every thirtieth year.

He also finds a cycle of 11 years, corresponding to the sun-spot cycle. This one, however, does not persist throughout the whole 300 years, and the author thinks that the real period (also emerging from his calculations) is one of not quite 5½ years, or almost half 11. A cycle found with a period of 35½ years also corresponds well with that discovered by Brückner as causing a regular alternation of dry, warm periods with wet, cold ones.

Sufficient records do not exist to enable the author to use data prior to 1550, but the records of historical famines show that

* "Wheat Prices and Rainfall in Western Europe," a paper read before the Royal Statistical Society on 25th April, 1922. This is in substance a sequel to an article by the same author on "Weather and Harvest Cycles," in the *Economic Journal* for December, 1921.

most of these occurred at dates which might be calculated by carrying back some of the cycles found.

The material actually used covers only the three centuries 1550 to 1850, the later years being entirely ignored in the investigation, for the reason indicated above, viz., that European prices of wheat since then (or at least since 1870) depend far more upon the harvests of the entire world than of the locality where the price is paid, and thus—as cycles probably affect different parts of the world differently — high prices would not necessarily indicate scarcity in western Europe. This precaution enables him to test the continuance of the phenomena since 1850, as well as their utility for prophecy, by comparing a calculated curve with actual results. He accordingly adds together the theoretical effects of the eleven best established cycles in each year, and constructs a "synthetic" curve—as he calls it—of wheat prices. Upon the assumption that, if we are looking for a single factor which is uniformly adverse to a good harvest, we shall get nearest to finding it in rainfall, the "synthetic" curve between 1850 and 1920 is compared with the curve of rainfall in western Europe during the same years, and the main peaks in the two are seen to correspond very closely.

Reference may be made to the deduction drawn by Sir William Beveridge some year or two ago as to the probability of heavy rain and bad harvests in 1923. This was taken by many people as a prophecy, but his later inquiries do not lead to the same conclusion as to the general meteorological condition of the near future, and such an interpretation is now to be regarded as withdrawn. He fully believes that trustworthy prophecy of the weather will, in due course, become possible, but that it is not yet possible on the facts as he has given them. Prophecy will become possible, if at all, only after detailed investigation has shown the nature, shape, relative importance, and, above all, local variations of each cycle. At present little more can be said than that such cycles exist and are noticeable as periodic changes in the rainfall. As his examination shows, these cycles do not necessarily persist indefinitely: many of them have persisted for centuries, but others have died away, or their periods have become modified. Such considerations render it dangerous to forecast the weather of any given year; and, in fact, the "synthetic" curve above referred to shows several discrepancies in certain years with the actual rainfall records, although

the most prominent peaks duly appear in both. While, therefore, the results obtained up to the present make it risky to assert that, because there was a particularly bad harvest in a certain year, there will be another bad one fifteen, or thirty, years later, continued investigations on the same lines should result in our being able to make such prophecies with a more reasonable expectation of their fulfilment.

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TRIALS OF NEW VARIETIES OF CEREALS.

PART I.

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THE paper deals generally with the subject of Variety Trials of cereals and specially with the methods which have been used by the writer with a view to securing comparative accuracy in the results of field tests of new varieties.

Terminology.—Wheat, barley and oats have each been divided by systematic botanists into several "species" and "sub-species," and each of these again into a greater or less number of "varieties." The number of varieties recognised 20 years ago was about 200 for the three cereals together. The number has now been greatly increased by the artificial production of hybrids. Varieties are again divided into "sub-varieties," "strains," "sorts" or "forms," signifying aggregates differing in respect of either minor structural characters or characters not always discernible to the eye but often of agricultural value, as, for instance, length of growing period, hardiness, stiffness of straw, root-range, ratio of grain to straw, disease resistance, etc.

It will be convenient to use some one word for the aggregates which are dealt with in variety trials. New productions are generally aggregates of plants the individuals of which have a common ancestry, and in variety trials we are concerned only with the inherited characters of the aggregates. The most descriptive term to apply to any aggregate under trial therefore appears to be *race*.

Some aggregates originating from selected individual plants having a hybrid ancestry, although apparently uniform in all their inherited characters, ultimately prove to be more or less variable. This fact must be recognised in interpreting results of variety trials but is too complex for discussion in this Paper.

Racial Characters.—The most valuable characters of any cereal race are those which affect its relative *productivity* in respect of grain as compared with other races of the same species. The measure of productivity is the weight of dry grain harvested and threshed from some unit of area.

Next in value to the grower is the *quality* of the grain in relation to the purpose for which it is most likely to be used.

Morphological or physiological characters and combinations of characters of any kind will be of value in proportion as they contribute to yield or to quality. The quantity and quality of the *straw* as feeding material or for other uses must also be taken into account.

From the above it is evident that variety trials of cereals are complex affairs. Moreover, the problem has many limitations and is beset by difficulties and sources of error especially in estimates of productivity, both in execution and in the interpretation of the results obtained. It is desirable to set forth some of these limitations and difficulties before describing in detail the methods which have been designed to deal with the problems involved.

Limitations of Yield Testing.—It is very improbable that with our present knowledge any new race of cereal will be produced which will give a higher yield of grain per acre than any and every already existing race of the same species under every condition of soil, season and cultivation. The same applies, although perhaps to a less extent, to quality of grain. The problem of the plant breeder is that of adaptation of the plant to external conditions, and all that can be expected from him is that he will produce new races better adapted to definite sets of external conditions than existing races in average seasons and under the best methods of cultivation.

In Great Britain there are no wide areas of uniform soil. The "lay of the land" and the dip of the strata combine to make uniformity impossible. There are doubtless many farms of 500 acres in Great Britain on which the soil is so variable that no one race of any species of agricultural plant is the best race for all parts of the farm. This may seem a hard saying, but let any critic try to find two adjacent pastures showing equal pro-

portions of different races of grasses. This results from the combined effects of artificial and natural selection and of adaptation, and there is no apparent reason why cereal races should not show a similar range of adaptability.

The plant breeder is limited in the early stages of the production of new races by the type of soil of his breeding plots and by the average climatic conditions of his station. The comparative yields and qualities of a particular race obtained at a station in the West of England, say on the upper greensand with an average rainfall of 36 in., may be quite different from those obtained, say on the "boulder clays" of East Anglia with a 24 in. rainfall. It therefore does not necessarily follow that the plant breeder's original determinations of relative productivity, however correct for his own conditions, will always be applicable to other localities.

Seasonal effects, even in a limited area, are very diverse. These together with the necessarily variable methods of manuring, crop rotation, and tillage may suit one race of a species better than another. Moreover, in some localities a quick-growing race may be necessary in the average of a series of years, as for instance the quickly maturing "Scotch Common" barley in Aberdeenshire. As a general rule, the more slowly maturing races will be the most productive, but superior yield may have to be sacrificed, if in, say one season out of three, there is a chance that the crop would fail to ripen.

It follows that all that can usefully be accomplished in any one year in the way of variety testing is to make accurate comparisons of races in respect of respective economic value, taking both quantity and quality into account, at different stations, selected for typical differences both of soil and of average climatic conditions.

Is the task of the cereal breeder then a hopeless one? Is an organization for testing new cereal races equally hopeless? It is by no means necessary to accept "counsels of despair," but in interpreting results of trials it is necessary to keep fully in mind the limitations and qualifications set forth above. These ar ein fact instinctively present to the minds of most growers, and it is because the practical farmer is aware of them that he frequently pays scant respect to variety trials and prefers to rely on his own experiences.

If it were desired to obtain systematic knowledge of the suitability of existing races to localities, no better plan could be adopted than for some representative body, like the Farmers'

Union, to organise a voluntary census of yields of varieties of cereals in different districts on the same principle and with similar objects as in the collection of milk records.

In the case of new races, however, the prospective grower will always have to rely on the experience and testimony of those who produce, multiply and distribute the original stock. He must expect to pay for this in the form of a high price for a few bushels of seed, which is all that he needs at the start in order to stock his farm within a few years, and even so he will sometimes be disappointed and find that the new race does not suit his land. On the other hand, if he gets a substantially increased return, due either to yield or to quality, or still better to both, the increase may easily be equal to the rent of the land and he may make much more than this for a few years by the sale of some of his produce for seed.

Now the position of the plant breeder is that unless he is very lucky the cost of producing a new race which appears to have some definite advantage in its favour is many hundreds of pounds, quite apart from any systematic series of field trials such as have now been inaugurated by the National Institute of Agricultural Botany, and if he proceeds at his own cost to field trials in different localities one of two things happens—either the new race gets into other hands than his and he gets no return, or he must establish an extensive organization for both multiplication and control. In the latter case he runs the risk of having to incur these costs and then find that his new race is after all "not good enough"—in which case it ought to be "scrapped," because the spreading of inferior races is a disservice to agriculture.

The above appear to the writer to be considerations which justify the efforts of the National Institute of Agricultural Botany to organise a system of variety trials for new races in the joint interest of plant breeders and purchasers of seed-corn, and generally in the interest of increased production of grain in the country.

Does what has been said above make it necessary to test great numbers of new races in a great number of localities and over a long series of years? It certainly shows the need for more systematic methods than have hitherto been adopted; but there are some comforting considerations. It is becoming evident that there are some valuable racial qualities, the presence or absence of which can be demonstrated by plant breeders themselves in a few years in one or a few localities on small areas, and which

may reasonably be expected to hold good under a wide range of external conditions. Illustrations may be given both with regard to yield and quality.

1. It is fairly clear that a race with a long growing period is likely to give a better yield than one with a short growing period, and therefore it is probably desirable to select for any locality a race with as long a growing period as the ordinary climate and farming conditions of that locality permit.*

2. The writer has shown that with some races of cereals (given complete ripening) a greater proportion of the total dry matter of the plant is accumulated in the grain than with others, and there is consequently a better proportion of grain to straw—an obvious advantage, because grain is more valuable than straw.†

3. Comparative "strength" in wheat appears to be quite definitely a racial character to a great extent independent of external conditions.‡

4. Immunity from certain diseases is also a racial character more or less independent of external conditions.§

The above are examples of characters which can be tested in the plant breeding stage. Further investigations of the factors of productivity and of quality together with elaborated nursery testing methods will probably tend to lessen the number of new races which are worth carrying forward to the stage of variety testing in the field.

Whatever may be the improved characters which the plant breeder has aimed at and hopes that he has obtained, the first essential in systematic comparisons on the field scale is that each comparison shall be, as far as is reasonably and practically possible, free from errors of experiment, and the next essential is that some reliable estimate should be made of the probable extent of the errors that are unavoidable. Unless these conditions are fulfilled it is not possible to proceed with any advantage to that interpretation of the results which will still be necessary and which should accompany the publication of them, if they are to be of service to future growers.

Errors of Experiment.—It is admitted that every separate field experiment is subject to unavoidable errors. If in a comparison of yields on different plots at any station in the same year the errors of experiment exceed the observed differences between the yields of the races under comparison, the results of that particular trial are valueless as yield trials. In variety

* Pedigree Seed Corn. Beaven. *Jnl. Royal Agr. Soc. of England.* Vol. 70, 1909.

† Breeding Cereals for Increased Production. Beaven. *Jnl. Farmers' Club*, Nov., 1920.

‡ Inheritance of Strength in Wheat. Biffen. *Jnl. Agr. Science*, iii, 86, 1908.

§ Inheritance of Disease Resistance. Biffen. *Jnl. Agr. Science*, ii, 109, 1907; iv, 421, 1912.

trials as hitherto carried out, the *probable errors** of the weights of grain have often been greater than the observed differences. Also, unfortunately, the existence of these probable errors has generally been ignored in published reports. Sufficient evidence of the universality and extent of probable errors in field trials may be found in the publications of (1) Wood and Stratton*; (2) Mercer and Hall†; (3) of the present writer.‡ It may at least be partly due to ineffective methods employed in variety trials and to consequent misleading reports of them in the past, that there has been so little increase in the average yields of cereals in Great Britain; for according to agricultural statistics the average yields of grain in Great Britain are still only about the same as they were 40 years ago. This record compares badly with what has been done with other agricultural plants and still worse with that of the horticulturists. The marked improvement in barley yields in Ireland is, however, an example of success directly due to systematic yield trials.

It has sometimes been tacitly assumed that if a set of trials of the same varieties are carried out at a number of different stations on different soils, the average results obtained give figures which are more useful than those obtained at any one station. If, as rarely happens, one variety gives better results than all the others at a number of stations there is no doubt a probability that it would have given comparatively good results under still other sets of conditions in the same season. What generally happens is that the order of merit varies at different stations in the same season and in different seasons at the same station. For this reason the averaging of results obtained at a number of stations, whilst useful, is at best of limited value. For example :—It is not of much use to a grower in Norfolk to be told that a certain variety of wheat grown in, say, Shropshire or even at several other stations, has given comparatively high yields if the external conditions at all the stations are different from his own.

Errors of experiment in variety trials are of two orders :— (1) Systematic, and generally avoidable; (2) Casual, and not generally avoidable. To the first class belong :—

* For the use and meaning of the term "probable error" as applied to agricultural experiments see "Interpretation of Experimental Results" by Wood and Stratton, *Jnl. Agr. Science*, Dec., 1910, also Supplement to *Jour. of the Board of Agriculture*, Nov., 1911.

† Experimental Error of Field Trials. *Jnl. of Agr. Science*, Vol. 4, Part II, Oct., 1911.

‡ Breeding Cereals for Increased Production. *Jnl. Farmers' Club*, Nov., 1920.

Character of Seed.—A necessary precaution which has often been neglected in variety trials is to make sure that the parcels of seed of the different races under comparison are equally representative. Very considerable differences in yield arise from differences in the physical, germinative, and other non-racial characters of the parcels of seed sown. These should not be neglected, just as for other reasons in a variety trial of potatoes we should not think of comparing Scotch grown " Arran Chief " with Fen grown " Up-to-date."

The function of a seed, as of a tuber, is to give the individual plant a start. Much depends on a good start, and varieties should not be irregularly handicapped in this respect.

The only practicable method of eliminating this probable source of error is to use seed of all the races under trial which has been grown and harvested the previous year under uniform conditions, and in case there is any substantial difference in moisture content it would be preferable that all the parcels of seed should be kiln-dried to an equal moisture content.

A very good parcel of seed of an inferior race of a cereal will sometimes give a better crop than an inferior parcel of seed of a better race, but there is no evidence that this accidental quality of the seed would be transmitted to the next generation.

Admixtures.—Another systematic error arises if any substantial admixture occurs in the seed of any race under trial. A very small percentage of admixture may be regarded as negligible. One per cent. of " rogues," if of an obviously different race of the same species will show quite forcibly when the crop is ripe, but if the " rogue " plants are only 10 per cent. less or more prolific than the rest, the difference in yield due to them will only amount to one-tenth of 1 per cent., which is negligible. If, however, the crop is to be used for sowing again, even such a percentage is very undesirable.

Casual Sources of Errors.—These are very numerous. They include soil variations due to a multitude of causes and extending over large or small areas, such as those due to previous cropping and manuring, soil bacteria, etc.; variations in sub-soil and in natural or artificial drainage; contour variations, such as slopes or furrows; irregular shading or uneven exposure to wind; patches of weeds of all sizes; inroads of insects, vermin, birds, etc., in patches. It is quite impossible to exclude these sources of casual errors and they may occur in either small or large patches. Their occurrence may be regarded as chance events and they may be all lumped together, because there is only one

way of discounting them, viz., to arrange and multiply the plots of each race at each station in such a manner as to give an approximately even chance of getting the same proportion of good and bad patches, and at the same time to keep the races to be compared as close together as possible in order to secure general similarity of soil conditions.

On account of these unavoidable casual errors the yields of cereals cannot at present be compared with the accuracy obtainable in physical experiments in the laboratory. With the help of the statistician, however, we may make steady approaches in this direction. The value of reliable results when they can be obtained is sufficiently great to justify the attempt.

Probable Error of Yield Trials.—Every farmer knows that he cannot obtain a fair sample of the grain threshed from a stack by taking a handful out of one bag. Neither is it possible to find the yielding capacity of a parcel of seed by sowing it on any one patch of ground, large or small. Still less is it possible to estimate the difference in the yielding capacity of two parcels of seed by sowing each of them on a single plot, even if the plots are side by side. To obtain sound comparisons, at any one station, it is necessary to average the results of a number of plots of each race. Having done this, if we have excluded systematic errors, we can calculate, by an arithmetical device based on the laws of probability applicable to chance events, the probable error* of the average result. Obviously the probable error of an average is likely to be less than that of any one plot, and the greater the number of plots the smaller is likely to be the probable error of the average.

Briefly stated, probable error is an average error computed in a particular manner in order to afford a measure of the unreliability attaching to any average of results by reason of the operation of chance conditions.

The degree of unreliability indicated by any probable error depends on the size of the probable error in proportion to the quantity to which it refers. For instance:—If the probable error of a difference between two averages of say 5 per cent. is as much as 3 per cent. it is an indication that the difference of 5 per cent. is one that might easily be due to chance conditions. If, however, the probable error of the same difference is only 1 per cent. it would be extremely improbable that such a difference (5 per cent.) arose entirely from chance conditions. If in com-

* For a full discussion of the theory involved see "An Introduction to the Theory of Statistics" by C. Udny Yule. 5th Edition.

paring the produce of a series of " control " plots of an established race " C " with a corresponding series of a new race "A" the result was :—

"C" = 100. "A" = 105 $\pm$ 1·0 per cent.

(where $\pm$ 1.0 stands for the calculated probable error as a percentage of " C ") we could be practically certain that the difference in favour of "A" was not a chance occurrence.

The following may be taken as a rough standard of the reliability of any comparison such as we are considering :—If an observed difference between two averages, each of a considerable number of cases, is more than four times the probable error of the difference, the difference may be regarded as *significant* in the sense that it is extremely unlikely to have arisen from the operation of chance events.

Since it is useless to expect a very rapid rate of advance in the yield of cereals from the breeding of new races, and since it is highly desirable that published conclusions should have a high degree of reliability, a " fine sieve " is required through which to sift results of yield trials. It is therefore suggested that a probable error of 1 per cent. or less in weight of grain should be aimed at in the difference between any two races at any station in any one year.

Before considering whether there is any practical arrangement of plots which will give this degree of accuracy it will be as well to see how this compares with the kind of results at present obtained in field trials. Before doing so it will be instructive to refer briefly to the probable errors which occur in the plant breeding stage.

The plant breeder usually proceeds year by year somewhat as follows :—

1. *Single plants of different races with equal soil space per plant.* The writer finds that with 12 sq. in. soil space per plant, and with all the plants of the same race and comparing adjoining plants the differences run from zero up to a quite indefinite maximum ; the probable error of the percentage difference is somewhere about 80 per cent. of the average weight of two adjoining plants. A difference of 300 per cent. between two adjoining plants is therefore not conclusive evidence of any racial difference, but may be due to conditions external to the plant. The probable error is much greater even than this for single plants under field conditions with necessarily wide differences in soil space per plant. It follows, although the argument cannot be developed here, that it is practically impossible to select single plants for racial productivity. Incidentally also it shows the great difficulty, if not impossibility, of adapting pot-culture methods to estimates of productivity, except in respect of very great differences.

2. *Rows of* 12 *plants with equal soil space per plant.* The probable error of the difference between two averages of say 12 *row* weights is likely to be

about 10 per cent., and comparisons at this stage may afford the plant breeder some slight but very uncertain indication of racial productivity.

3. *A chessboard of plots—each planted with the same number of seeds with equal soil space per seed.* This method has been followed by the writer since 1910 in nursery cultivations at Warminster, and has been adopted also by the Irish Department of Agriculture and the Cambridge Plant-breeding Station.

Where the plots are 16 sq. ft. at seeding time reduced to 9 sq. ft. for harvesting by eliminating margins; the plot of each race repeated 20 times (giving about 2,000 plants of each race); the whole area protected from birds; the produce of each plot weighed; the water-content determined and the dry weight computed; the probable error of the difference between the total dry weights of any two races is found to be about 4 per cent. By this method eight different races can be compared to this degree of accuracy on less than ten perches of ground, when half a pound of seed of each race is available. Estimates of comparative yield based on these nursery chessboards are generally, but not always quite closely, confirmed by field trials of the same races on similar soils in the same season. The results obtained on 12 such chessboards since 1910 are now being summarised for publication. This method undoubtedly provides a means of sifting out those races which are worth carrying on to the field trial stage.

Proceeding now to systematic attempts to estimate the magnitude of the probable error to be expected in field trials, Wood and Stratton, in the paper already referred to, from a very large number of published results estimate that the probable error of single plots of any size over 1/40th of an acre is generally about 5 per cent. of the produce of the plot. This gives a probable error of 7 per cent. as that which may be expected when comparing any two adjacent single plots.

This is fully confirmed by Mercer and Hall in the paper already referred to, and in addition there is described in this paper the most elaborate experiment of which there is any record in this country with the object of determining the number of plots required to be averaged to produce a prescribed probable error. An acre of wheat of one variety selected for apparent uniformity was divided at harvest into 500 equal rectangular plots and the grain and straw from each plot was weighed. This was a great undertaking—only possible at such a station as Rothamsted. The mass of figures was very thoroughly investigated on statistical lines, not only by Mercer and Hall, but also by "Student" in an Appendix in which a still more elaborate statistical method was devised and shown quite clearly to lead to a further reduction in the probable error.

In this experiment the actual difference in the weight of grain between the two half-acres on the east and west of the acre was 8.3 per cent. If, therefore, this acre of ground had been used for a trial of *two* varieties—one single half-acre on the east and one single half-acre on the west side—there would obviously

have been an actual error of about 8.3 per cent. in the comparison between the two races due, not to racial characters, but to soil and other conditions external to the plant. In other words, the experiment would have been (as most variety trials in the past have been) a combined trial of soil fertility and race productivity, and it would have been impossible to disentangle the two. When, however, comparison was made of the weights grown on the 250 pairs of adjacent plots, it was found that the probable error of the average difference between all adjacent plots taken in pairs was reduced to less than half of 1 per cent. If therefore 250 plots of each of *two* races had been planted in alternating strips of plots across the field, it may be assumed that whatever was the difference in the total weight of grain of the two races, the probable error of this difference due to soil conditions would have been only about half of 1 per cent. and that if the actual difference amounted to 2 per cent., viz., four times the probable error, it might safely have been regarded as significant.

It becomes a problem in statistical inference to estimate the number of comparisons necessary with plots of any specified area in order that the probable error under any fairly normal external conditions shall not exceed, say, 1 per cent., and also to find the best way of splitting up any available area into such plots.

Consideration of the above results, and more especially of the contribution by " Student," suggested to the writer a method of yield testing for barley which after some early preliminary experiments was commenced at Warminster in 1920 for field tests of two different races.

The method appears after two years' full trial to be practical, and also economical of area, and furthermore to be adapted to reduce the probable error of yield trials of cereals to a very small percentage of the observed weight of the crop.

This method may be called the " half-drill-strip " method and will be described in Part II of this paper with a summary of the results so far obtained. It is in course of trial by the National Institute of Agricultural Botany this year for oats and barley. Whilst it presents distinct advantages there are still difficulties to overcome and it can probably be further improved on.

(*To be concluded.*)

THE REVIVAL OF VILLAGE INDUSTRIES:

THE WORK OF THE RURAL INDUSTRIES INTELLIGENCE BUREAU.

MAJOR L. SHOETEN SACK, O.B.E.

THE decline of rural non-agricultural industries as an important factor in the economic life of this country dates from the introduction of machinery. With the gradual supersession of handicraft by mechanical means of production, there began a steady transfer of nearly every form of manufacture to the towns, with a consequent withdrawal from the countryside to the urban areas of the workers required to man the newly erected town factories.

The tendency continued unceasingly until the centralization in towns of every form of factory and workshop came to be regarded as the natural direction of all industrial development. The countryside was considered as being suited only to agricultural work, and the towns claimed control of all manufacturing industries, even of those where the element of handicraft continued to predominate over the partial mechanical processes.

As a result of this policy, the break up of the hitherto prosperous village industries was as inevitable as the steady depopulation of the countryside. To-day, with isolated exceptions, the few rural industries which have survived are carrying on a precarious and languishing existence. Too frequently they are managed by enthusiastic but insufficiently experienced amateurs; often their policy is directed by local sentiment rather than by business principles; usually they are out of touch with the rapidly changing market conditions and are, therefore, unable to face the keen competition of their urban competitors.

The outcome of the social revolution consequent on the introduction of machinery has, therefore, been (*a*) to depopulate the countryside to such an extent that at present only 15 per cent. of the working population are country dwellers, and (*b*) to make the livelihood of even that proportion dependent almost solely on agricultural work by withdrawing the stabilizing effect of a successful non-agricultural industry suited to local conditions and seasons.

In most continental countries, the retention of profitably worked village industries has been encouraged by carefully planned schemes of Government action, having for their object

the relatively even distribution of population and industries throughout the country. Germany, more than any other continental country, has worked out its distribution of industrial activities on a considered plan, but other countries have not neglected the problem; for example, the French rural industries employ more than $1\frac{1}{2}$ million persons, and in Switzerland the prosperity of rural industries is closely associated with agricultural life.

So disproportionate has the rural population of this country become and so serious is its threatened effect on agriculture, that the problem of improving the conditions of life of the rural worker has for several years received the serious thought of the Government and of leading agriculturists and economists. The more closely the matter is explored, the more definite appears the conclusion that the revival of rural industries must form an essential factor in the stabilizing and revitalizing of the countryside.

Already in pre-war days the rural worker was being influenced to a larger and broader outlook on life by improved education and the more frequent reading of the daily press. The War has here, as in so many other directions, had a decisive effect. The rural soldier returned to his village with new experiences and greater ambitions and his ideas rapidly spread to his fellow inhabitants. The countryman now demands for himself and his family greater security and wider prospects for the future than the exclusive dependence on agriculture can offer. Disregarding even the seasonal nature of much agricultural work, the farm worker can gain a livelihood only when he is strong and able-bodied. Purely agricultural work offers but rare chances of employment to his wife, to any of his children whose health is failing or to himself should he become physically weakened. Inevitably, therefore, the more progressive villagers are attracted to the towns where the greater variety of openings seems to offer a better future for himself and his family.

Again, on grounds of high economic policy, it is desirable that the continued centralization of all industries in the towns should be checked and that a process of decentralization should be begun by transferring to the countryside some of those industries which are still largely dependent on handiwork and in which the use of modern mechanical processes is subsidiary. The increasing congestion in towns is clearly undesirable on social grounds. But further, in many industries cheaper production should result owing to the reduction of numerous " overhead " charges which are frequently much inflated in towns.

The importance of rural industries in meeting the pressing problem of the disabled soldier cannot be overlooked. There are probably 100,000 or more ex-soldiers whose state of health unfits them both for the conditions of work in town factories and for the arduous routine of the agricultural labourer. To such men, capable often of only part time work, the village workshop seems to offer the employment most likely to encourage their ultimate return to health.

The pressing importance of these and other aspects of rural industries development had for some time engaged the attention of the Development Commissioners. After calling for expert reports on the matter and thoroughly exploring the whole subject, the Commissioners approached the Treasury for a grant to enable some central organization to be established with a view to providing a recognized centre for the distribution of authoritative, advice and reliable data affecting the revival or establishment of rural industries. The Treasury sanctioned the grant, and accordingly the " Rural Industries Intelligence Bureau "* was formed under a Trust Deed with the following trustees appointed by the Ministry of Agriculture :—Major-General Sir Gerard M. Heath, K.C.M.G., C.B., D.S.O.; Sir Charles McLeod; Sir Basil Mayhew, K.B.E., F.C.A.; Sir Douglas Newton, K.B.E., M.P.; The Hon. Edward G. Strutt, C.H.

The Committee has as its Chairman the Right Hon. Lord Ernle, P.C., M.V.O., and is composed of the trustees in association with representatives of the Board of Trade, the Ministry of Health, the Board of Education, the Ministry of Agriculture and Fisheries, the Ministry of Labour, the Board of Agriculture for Scotland, the Ministry of Pensions, the Forestry Commission, the Labour Party, the British Legion and all other interested associations.

The Director of the Bureau is Mr. E. Cecil Kny, who has devoted much time to a practical first-hand study of the rural industries in most European countries and combines with this intimate knowledge of rural organization a wide technical knowledge of the industries mainly affected.

The Bureau is thus controlled by a body equally representative of social interests and of technical and business experience. It is essentially an organization set up for practical purposes. The constitution of the Committee seems to indicate that in dealing with the many important questions that await settlement, the wider national outlook will be associated with the parochial

* 258/262, Westminster Bridge Road, S.E.1.

standpoint, and modern business methods will have due regard to practical local sentiment.

The primary purpose of the Bureau is to offer skilled advice to those who are engaged in, or contemplate, the establishment of commercially profitable rural industries. The following may be quoted as typical subjects on which the Bureau will be able to offer the considerable assistance of their wide investigations and complete reference data :—

(*a*) The revival of lapsed, and the extension of existing rural industries on sound economic lines.

(*b*) The economic possibilities of establishing, in any particular locality, industries hitherto carried on exclusively abroad.

(*c*) Commercial organization, *e.g.*, questions of costing, designing, training, and choice of processes.

(*d*) Market intelligence, including reports on home and foreign markets, freights, etc.

(*e*) The decentralization of urban industries which could be better carried out in rural areas.

The policy of the Bureau will not be restricted by any rigid rules or formulæ. It is recognized that no hard and fast system is suitable for, and still less can be imposed upon, every part of the country. Normally, it will rest with the local inhabitants to take the initiative by considering what form of industry is most suited to the particular local conditions, having regard to such considerations as the natural sources of power, the railway service, the facilities for obtaining the requisite raw materials, etc. The Bureau will where desired give preliminary advice as to the general principles which will probably be necessary to ensure the commercial success of any scheme; when the preliminary scheme has been worked out, the Bureau will be in a position to go into the commercial possibilities of the proposals more closely.

While the initial purpose of the Bureau is, as has been explained, to act as an expert adviser, it is recognized that in many cases the successful management of newly established industries may require further practical assistance in obtaining reliable material at reasonable prices and in securing a good market for the manufactured articles. In conjunction with the Bureau, therefore, a co-operative trading society, known as the Country Industries Co-operative Society, has been established also at 258/262, Westminster Bridge Road. The working scheme of this Society will be explained in an article in a later issue of this *Journal*.

THE LINCOLNSHIRE CURLY COATED PIG.

SANDERS SPENCER.

THERE appears to be little doubt as to the locality in which the Lincolnshire Curly Coated Pig originated, since in no other county than Lincolnshire is there found a breed of pig of a similar type and character. It is true that some forty or fifty years ago there was to be found in County Cork an occasional pig with very curly hair, but this was of quite a different character to the curly hair of the Lincolnshire pig as it was much softer and more like wool than hair. Further, the County Cork type of pig did not seem to possess that robust constitution which is so characteristic of the Lincolnshire pig. It had more the appearance of a pig which had been so interbred as to lose its constitution and which had entered on its last stage. The subject of these notes is in every respect the exact opposite, as it certainly appears to have been vastly improved, not only in constitution but in form and substance since classes for the breed were included in the prize schedule of the county agricultural society. The writer's first experience of the North Lincolnshire pig was in the fifties of the past century when the curliness of the hair was not so generally noticeable, nor did the pigs of that period possess in so marked a degree the quality of early maturity. Then, as now, the sows were prolific and good mothers, whilst the pigs were very hardy, but they required to be of considerable age before they responded readily to the fattening process. This resulted in fat pigs of a size and degree of fatness which would not find favour in the eye of the consumer of the present day, even in Lincolnshire where the average fat pig killed for consumption on the farm would scarcely pass muster at any market outside the particular county.

The probable reason for the very heavy and fat type of pig finding favour in the county of Lincoln was that, in the northern part of the county especially, a considerable proportion of the horsemen, cattle men, and shepherds used to live in the farm houses or in the houses of the ground keepers or foremen, the latter receiving from the farmer a certain weight of bacon annually in part payment of the cost of keep of the men. Both in the farm house and in the ground keeper's house bacon formed the chief meat consumed by the men, whose appetites had not been pampered, so that they made no objection to fat bacon made

FIG. 1.—Lincolnshire Curly-Coated Boar.

FIG. 2.—Lincolnshire Curly-Coated Sow.

from old and matured pigs which was neither so delicate in flavour nor so tender as is the most highly priced bacon of to-day. It has, however, the desired qualities of satisfying at little cost the appetites of the men and of enabling them to perform their somewhat arduous duties on the farm, or in other words, the Lincolnshire Curly Coated pig has been most successfully bred to meet the requirements of the farmer. It fulfils in the most complete manner its duty of supplying at a fair cost a large carcass of fat pork within a reasonable time. Indeed we think that its breeders are justified in making the claim that no other breed is more suitable, if so suitable, for the special purpose for which the curly coated pig is mainly kept.

It might not be so great a favourite when transported from its native county to the southern portion of this country, but there can be no doubt that a considerable proportion of the common country pigs would be more readily fattened and at less cost did they possess an infusion of the blood of the curly coated pig.

The vast improvement in the Lincolnshire pig which has taken place during the last half-century may have had its influence on the system of pig keeping in the county. In the olden time the fatted pig would be a year and a half to two years old and not infrequently it would also be a young sow which had reared one litter of pigs, as the far too common practice was to utilize the extended growing period of the female pig by breeding a litter from the young sow and then fattening her. The quality of the resultant pork would suffer somewhat, but this was not considered to be of any great importance owing to the absence of fastidiousness of taste in the general consumer. The farmer, however, handicapped himself very considerably in the improvement of his pig-breeding stock, as by fattening off the young sow after she had reared one litter of pigs, it was impossible to make a selection of the sows which were the best producers of large litters of those pigs which would grow and mature most quickly. A permanent and considerable improvement in any breed of live stock can only be assured by the continuous selection of those sires and dams whose produce most nearly approaches the standard of excellence of the breed. We believe also that the system of mating a young boar with gilts, then castrating and fattening the boar as soon as the gilts are in pig, has ceased to be followed to so great an extent as in former times. It is to be hoped that still further improvement may soon be carried out

by the complete discontinuance of these old practices, which are now followed only in the breeding of ordinary pigs on the farms.

The following is the official scale of points:—

Colour.—White.	
Face and Neck.—Medium length and wide between the eyes and ears	5
Ears.—Medium length and not too much over face	10
Jowl.—Heavy	3
Chest.—Wide and deep	3
Shoulders.—Wide	15
Back.—Long and level	10
Sides.—Deep, and ribs well sprung	10
Loin.—Broad	5
Quarters.—Long, wide and not drooping	5
Hams.—Large and well filled to hocks	15
Tail.—Thick and set high	3
Legs.—Short and straight	5
Belly and Flank.—Thick and well filled	3
Coat.—Fair quantity of curly or wavy hair	8
	100

Objections.—Narrow forehead, thin ears.

Disqualifications.—Pricked ears, dished or long nose, coarse, straight or bristly coat, any other colour of hair than white.

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HOP "CANKER" OR "GROWING-OFF."

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HOP "canker" has been known for the past thirty or forty years, if not longer. It is known generally in Kent, Sussex, Surrey, Hampshire, Herefordshire and Worcestershire as "canker,"* but in many districts of the Weald of Kent and of Sussex, farmers as well as foremen in the hop garden give the disease the descriptive name of "growing-off."

A short account of the disease was published in 1902 by Professor John Percival,† who wrote: "I have noticed examples as early as the end of June, but it is most frequently noticed later in the season, and in many cases the bine may remain connected as it were by a mere thread almost up to the time of hop-picking and then suddenly droop and die with its load of hops in an hour

* The present disease must not be confused with that occasionally caused by the grub, or caterpillar, of the Ghost Moth (*Hepialus humuli*), which lives underground and bores its way into the rootstock of the hop.

† Jour. S. E. Agric. College, XI, 87-89 (1902).

or two. On scraping away the soil, the lower end of the bine will be found completely severed from the parent plant."

The cause of the disease was attributed by Professor Percival to the fungus *Fusoma parasiticum*. During the past ten years the writers have had, from time to time, opportunities for studying the disease, and have been able to confirm the general conclusions arrived at by Professor Percival.

Description of the Disease.—Above ground the presence of the disease is indicated by a wilting of one or more bines at each affected "hill"; such bines are usually found to be almost severed at the base and easily come away from the rootstock with a slight pull, a condition which, as noted above, is sometimes described by growers as "growing-off" of the bines. This wilting of the bines is accompanied by a canker of the underground rootstock, the infected portions being brown and dead.

The basal parts of diseased bines which have been dead for some time often bear white pustules of a fungus, the conidia produced on these pustules being of the *Fusarium* type. Bines just beginning to wilt may not show these pustules, but usually the bark and even the wood is brown, and *mycelium* of a fungus is to be found in the brown tissues. In experiments where particles of such brown tissues were placed on sterilized culture-media, the fungus grew out and eventually gave rise to the *Fusarium* fructifications.

If the bines become infected but are not killed until late in the season, their bases become abnormally thickened, presumably owing to the accumulation of foodstuffs travelling downwards from the leaves and unable to reach the rootstock because of the partial severance of the tissues at the junction of bine and rootstock. These swollen bases become invaded by the fungus, which produces its fructifications at the surface. If the fungus is not fruiting at the time the hill is "cut" or "dressed," *Fusarium* fructifications almost invariably appear within a few days if the basal part of the bine—known as a "strap cut" when used for propagation—is kept in moist air.

A serious outbreak of the disease in a "Bramling" hop-garden came under the writers' notice in 1914, and the following notes on observations made there will serve to illustrate a typical case of hop-canker. Many hundreds of bines had been killed during the first three weeks of June of that year. By the end of the month the damage had almost ceased but the check was probably only a temporary one, as in previous infestations in the same hop-garden a certain further number of bines died

later in the season when bearing hops. Some of the diseased bines were quite detached from the rootstocks, and others showed various stages in the process of becoming separated. Many of the dead bines were found to be bearing *Fusarium* pustules when examined in the hop-garden; in some cases the pustules had developed while covered with two or three inches of soil. In very rare instances the separated bines were found to have produced tufted growths of adventitious roots, mostly from the nodes, in the region between the plane of separation and the surface of the soil.

It is noteworthy that this Bramling garden was on land which had not previously borne hops and the plants were only about four years old; the soil was loamy and certainly not to be described as a wet soil. In a few hills all the bines had been killed and only such hills were, in practice, grubbed up and destroyed. As a rule 1 to 3 out of the six bines trained up from a hill had been killed; such hills were not grubbed up.

A number of hills which had lost 1 or 2 bines during the summer were marked and examined in the following March, when it was found that in each case some or all of the remaining "straps" (bases of the bines) were diseased, a slight pull usually being sufficient to sever the connection with the rootstock; in one hill only were all the "straps" securely connected with the rootstock and, on cutting, it was found that two were sound throughout while the third showed a trace of decay on one side.

Where the straps were not wholly destroyed the decay in every case was at the lower end, the upper end being still alive and bearing young shoots. This indicates that the disease spreads from the crown of the rootstock into the straps. One such strap which was carefully examined showed a sharply marked margin at the upper limit of the diseased tissue which extended to about the middle of an internode, the lower node bearing dead buds, the upper living ones. The same sharp demarcation of the brown dead portion was also seen on cutting the "strap" longitudinally, and on making a microscopic examination fungus mycelium was found in the brown tissues up to one or two layers of cells from the sound tissues; mycelium was not found actually in the cells not discoloured. The mycelium present was proved to be that of the *Fusarium*.

It was the practice in this garden, at the time the hills were cut, to remove the straps almost immediately and burn them; at the time of the visit (March) this was being done, the

FIG. 1.—Hop-canker, showing "growing off" of bines (stems) from the rootstock; the one on the left is completely severed. Of the three bines attached to the rootstock, the one on the left is partly severed. The detached bine, from the same rootstock, shows how the fungus (pustules of which are evident at X) has eaten away the base of the stem, leaving only a tapering slender point of attachment. (*Nat. size.*)

FIG. 2.—Portion of crown of hill, showing the thickened bases of two bines. The fungus is seen at the lower end of the bine on the right. (*Nat. size.*)

fire being at the side of the garden. However, a few straps from diseased hills had been left lying on the ground for about two days and on some of these there were pustules which proved to be the fructifications of the *Fusarium*, although none of the hills, as they were uncovered and examined that day, showed any pustules. It is evident therefore that if diseased portions of the plants are not destroyed immediately, but are left lying about in the hop-garden, they serve for the continued development and dissemination of the fungus. It seems probable that the fungus can remain alive even when the " strap cut " in which it is living becomes desiccated. Infected " strap cuts " from the hop-garden referred to above were brought into the laboratory in June and allowed to become air-dried at room temperature. In the following February they were moistened and placed on damp filter paper in a covered dish. Within four days mycelium had grown out and already conidia, in general resembling those seen on the freshly-killed straps but not produced in definite pustules, had developed. The rapid development of mycelium and fructifications suggests that the growth had arisen from internal mycelium rather than from chance conidia on the surface, but the experiment must be repeated under more controlled conditions for confirmation of this point.

In another case, the farmer has described the damage inflicted as follows :—" In some years, in my Rodmersham Golding hop-garden, I lose a small percentage of bines, which die off both in burr and in full hop. One season we had a most disastrous time —they were a wonderful looking crop, till they started dying both in burr and hop and continued to do so up to and through picking. I should say we lost about 30 per cent. of the crop."

In some cases " canker " may appear soon after the planting of the hops. A Worcestershire grower wrote in 1914 :—" I am sending you the enclosed hop roots. They were planted last year as yearling roots. You will notice that the body of the plant is going rotten. There are thousands of plants like them in the hopyard." The specimens sent bore the same fungus as found in other cases of hop-canker.

As will be inferred from the above accounts, hop " canker " is a sufficiently serious disease to cause appreciable damage. As a rule only a certain number of the " bines " on any one hill die off, and the whole plant—the " hill "—is not generally killed. Cases have occurred, however, where from 5 to 10 per cent. of the hills in a garden have been completely killed. Where the hops planted belong to a variety which is particularly suscep-

tible to "canker," a certain number of dead hills are almost invariably to be found.

Varieties Susceptible to "Canker."—Some varieties of hops appear to be more susceptible than others. In the Weald of Kent and Sussex, Bramlings and Tolhurst are severely attacked; Fuggles do not escape the disease, but the injury inflicted is not usually so great as in the above-noted varieties. In East Kent the variety Rodmersham (or Mercer's) Golding has proved particularly susceptible; Bramling to a less degree, while Cobbs and Old Golding are little affected.

In Worcestershire the Mathon White is very liable to the disease, and in Hampshire the Farnham Whitebine.

Influence of Soil Moisture.—While by no means confined to hop-gardens on heavy, wet soils, the disease does appear to be favoured by moist conditions. The general experience of hop-growers is that "canker" is worse in a wet season or following a wet winter. If there is a wet clayey patch in a garden, the "hills" are likely to be more severely attacked there than in the other part of the garden, and that side of a garden which gets least sun will frequently show the greater number of diseased hills. A grower in East Kent writes:—"My garden of Rodmersham Goldings which was so severely attacked by "canker" lay rather low and damp, and somewhat shaded from the early morning sun; the soil is a deep loam overlying brick earth. I grubbed this garden and it has not been replanted, but I planted up some Rodmersham Goldings in another garden which has a lighter and sharper soil, with a gravel and chalk subsoil. The plants do not crop so heavily but on the other hand we have much fewer losses by dead hills or dying off after the bines have reached the top wire."

The Fungus Causing the Disease.—The constant association of the *Fusarium* fungus with the disease, and the fact that this fungus can be directly isolated as a pure culture from tissues of the hop-plant bordering on the healthy parts supply strong presumptive evidence that the fungus is the cause of the disease.

Inoculation experiments carried out by the writers on hop sets, although not conclusive (owing to the fact that some of the control sets contracted the disease) give further evidence in the same direction.

Eight hop sets were inoculated with the fungus (by placing on the cut surface mycelium from a pure culture) and planted up in pots; all gave rise to diseased plants, six of them becoming

cankered and producing *Fusarium* pustules; the other two produced wilted bines but when examined no *Fusarium* pustules were present. Of the four "control sets," planted up at the same time but not inoculated, two also became infested with the *Fusarium;* the other two produced healthy shoots.

Preventive Measures..—*Direct.*—(1) In several cases hard "cutting," or "dressing." of all the hills in the affected part of the garden has been advised, and success has followed this treatment. All the browned part of the hill (rootstock) contiguous to the swollen or "cankered" bines should be pared away with a sharp knife. The experience of many observant hop growers has led them to believe that a thorough "cutting" or "dressing" of the hills is the best treatment for "canker."

(2) All dead hills in the garden should be grubbed up *and destroyed.*

(3) In the affected part of the hop-garden all the cuttings from the hills should be collected and destroyed when they are cut, as the fungus causing "canker" will develop on the swollen cut-off "straps," and may infect the cut surface of the plant in the hill.*

Indirect.—Drainage, or cultivation to remove the moisture of wet land, or letting in the sun, appears to have a favourable effect on keeping "canker" in check.

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COUNCIL OF AGRICULTURE FOR WALES.

THE half-yearly statutory meeting of the Council of Agriculture for Wales was held at the University College of Wales, Aberystwyth, on the 19th May, 1922, under the Chairmanship of Mr. W. S. Miller, who was re-elected to the Chair for the year 1922.

There was a representative gathering of members and the Minister of Agriculture and Fisheries (Lt.-Col. the Right Hon. Sir Arthur Griffith-Boscawen, M.P.), Mr. C. Bryner Jones, C.B.E., Welsh Secretary, and other Officers of the Ministry were present.

Address by the Minister.—The Minister gave a general review of the situation in regard to agriculture during the preceding six

* A farmer writes to us: "This year for the first time we are collecting and burning everything cut from the hill at 'dressing' time in the garden of Tolhursts that has 'canker' badly."

months, and, in the course of his remarks, referred to the anxious times through which the agricultural industry had been passing after the comparative prosperity of the war period. The situation was rendered more difficult as a result of the outbreak of foot-and-mouth disease, which was the severest visitation of the disease that this country had experienced since 1883. On the other hand, the reduction in the wages of agricultural labourers, which was inevitable having regard to the fall in the prices of agricultural produce, had afforded some compensation to the farmer. He expressed gratification over the fact that the necessary adjustment in wages had been made in a spirit of conciliation and goodwill, which was essential in order to ensure peace on the farm, without which it would not be possible to secure prosperity. The Ministry had, on its part, taken prompt measures to meet the Corn Claims, which, with the exception of those in regard to which queries had been raised, were all paid in the early part of January.

Dealing with the report of the Committee on National Expenditure, the Minister stated that he had been able to prevail upon the Government, in spite of the recommendations made by the Committee, to preserve the Live Stock Scheme, with the exception of the sections relating to Heavy and Light Horse Breeding. It had been found possible also to retain, in addition to the Grant of £850,000 provided under the Corn Production Acts (Repeal) Act for the promotion of agricultural development in England and Wales, the full provision already made for aiding agricultural education and research. He explained in detail the position as regards the proposed allocation of the fund of £850,000 to different services and emphasised the fact that no money would be allocated from the fund for the completion of schemes for the establishment of Farm Institutes pending a decision as to the amount required for research into animal diseases.

Proceeding, the Minister called attention to the benefits derived by the agricultural industry from the land drainage schemes adopted for the alleviation of unemployment and to the steps taken by the Ministry to secure a settlement of the difficulty as regards milk prices. Amongst other things he referred to the relief given to the farmer in the Budget that had been recently introduced, which provided for assessments under Schedule B for income tax purposes to be made in future on the basis of the annual value. In conclusion, while admitting that the rating question remained to be dealt with and that under the present

system the farming industry was undoubtedly over-rated, he expressed the hope that it would be possible in the near future to place the matter on a proper basis.

The Chairman proposed and Col. Curre seconded a vote of thanks to the Minister.

Importation of Store Cattle.—The question of the importation into this country of live store cattle from Canada was again considered and the following resolution, which is in the same terms as the resolution passed at the previous meeting of the Council, was, on the proposition of Mr. C. D. Thompson (Glamorgan), seconded by Mr. G. B. Bowen (Pembroke), carried *nem. con.*:—

"That the Council of Agriculture for Wales strongly protests against any proposal to remove the present embargo on the importation of Canadian cattle, and calls upon the Ministry of Agriculture to take steps to ensure that the interests of the agriculturists of this country are safeguarded in this matter."

Report of Live Stock Committee.—In submitting the report of the Live Stock Committee, Mr. G. B. Bowen, Chairman of the Committee, called attention to the increased number of sires placed out under the Live Stock Scheme in Wales and Monmouthshire. Although the heavy horse grants had been discontinued, it was particularly gratifying to find that five milk recording societies were at present carrying out operations in the Principality. The Committee had at its meeting held on the 28th April adopted proposals for the allocation of the grants available for Wales for 1922-23, viz., 110 boar grants, 245 bull grants and 16 ram grants. He moved the adoption of the report and the motion was seconded by Mr. S. T. Griffin (Monmouth).

On being put to the meeting the report was adopted.

Report of Committee on Agricultural Policy.—The Council then proceeded to consider the report of a Sub-Committee appointed at the previous meeting to draft suggestions for the formulation of an agricultural policy for Wales. Mr. Bryner Jones explained that the Committee had met on two occasions to consider this matter, and after fully discussing various aspects of the question had asked him to draft a report embodying generally the views expressed at the meetings of the Committee. As indicated in the memorandum circulated with the report, the Committee, when they met subsequently, were unable to agree without reservations to all the recommendations included in the report, but it was their unanimous desire that the report as drafted should be submitted to the Council for discussion.

After considerable general discussion it was agreed that detailed consideration of the report be deferred to a special meeting of the Council to be called for the purpose at the end of three months.

Credit for Farmers.—Consideration was given to the report of the Sub-Committee appointed by the Agricultural Advisory Committee for England and Wales to consider the question of providing further credit facilities for farmers. On the motion of Mr. Griffin (Monmouth), seconded by Mr. C. D. Thompson, and supported by Mr. William Edwards (Anglesey), it was decided to support the recommendations embodied in the report.

Agricultural Statistics.—Mr. Bryner Jones called attention to the memorandum which had been circulated to the members in regard to the proposed Bill for dealing with the collection of Agricultural Returns and stated that the Ministry would be glad to receive an expression of opinion on the part of the Council as to whether it was desirable that a Bill should be promoted with a view of making it compulsory upon holders of agricultural land to furnish the information required in the annual Returns.

Mr. C. D. Thompson proposed and Mr. Thomas Williams (Montgomery) seconded the following resolution, which was carried unanimously:—

> "That provided the information furnished by individual farmers is not disclosed or used for any other purpose than the compilation of agricultural statistics this Council approves of the proposal of the Ministry of Agriculture to promote a Bill making it obligatory upon farmers to supply the particulars required in the annual Agricultural Returns."

The half-yearly report (No. 3) of the Proceedings of the Agricultural Advisory Committee for England and Wales, dated the 10th May, 1922, was received by the Council.

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VARIETIES OF SWEDES RESISTANT TO FINGER-AND-TOE.

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ALTHOUGH it has become widely known that clubroot or finger-and-toe (*Plasmodiophora brassicae*) can be eliminated, or at least greatly reduced in severity, by the application of lime, there is no indication that the disease is actually being controlled on any large scale. Individual farmers, of course,

have succeeded in stamping out clubroot, but in general the position in the country with regard to this disease has not changed very appreciably during the last twenty years.

Whilst it is true that liming is not usually resorted to on the scale which is found necessary to check clubroot, this is not altogether to be attributed to slackness or lack of knowledge on the part of farmers, but in many cases to the real difficulties experienced in carrying out remedial measures.

It is perhaps significant that clubroot is serious in stock-raising districts in the North of England, and in North Wales—essentially pastoral areas. These districts have, generally speaking, a soil rich in humus and a relatively high rainfall—factors which will tend to reduce soil aeration and presumably to increase soil acidity. Moreover, under these conditions lime will often be applied to grass in preference to arable land. Incidentally it may be observed that liming is a costly and laborious operation. The cost of applying two tons of lime at present prices will be at least £5 per acre, and in some cases—as in North Wales—where a farm may be as much as ten miles from a railway, the cost and labour involved become prohibitive.

These facts, taken in conjunction with the opportunities which occur for infecting land through farmyard manure and the common farm practice of feeding off roots to sheep on grass which will eventually be broken up, often result in the soil being kept permanently contaminated with clubroot spores.

So long as these conditions exist it is not reasonable to expect any radical change in the extent to which lime is employed and the uses to which it is put. It becomes necessary therefore, to determine whether any other method of controlling the disease is available.

The most obvious alternative is the production of resistant strains of swedes which can be relied upon to give a good crop even on land badly contaminated with clubroot. This possibility has received the attention of some seedsmen in this country, and in Denmark several highly resistant kinds of swedes have been produced by selection from two old Danish varieties, Klank and Bangholm Pajberg.

Preliminary Trials in 1920.—With a view to testing the resistance of varieties of swedes to clubroot under the conditions usually prevalent in North Wales, preliminary trials were laid down on three farms in 1920. In these trials eleven British varieties were tested alongside two Swedish and two Danish kinds. Although the season was an abnormally wet one (dis-

TABLE I.

Results with English and Danish Varieties at Dinas on Limed and Unlimed Plots.

	LIMED PLOTS								UNLIMED PLOTS							
	No. of Sound Roots	No. of Bad Roots	No. of Destroyed Roots	Intensity of Attack Max'm. = 20	Total Weight of Crop per acre		Est'd. Weight of Sound Roots when lifted, per acre		No. of Sound Roots	No. of Bad Roots	No of Destroyed Roots	Intensity of Attack Max'm. = 20	Total Weight of Crops per acre		Est'd. Weight of Sound Roots when lifted, per acre	
					tons.	cwt.	tons.	cwt.					tons.	cwt.	tons.	cwt.
Lord Derby	70	162	4	6·9	13	0	3	18	32	199	4	8·8	14	14	2	0
Danish Variety 4 ...	189	87	0	3·2	12	18	8	16	136	133	1	4·9	14	8	7	8
Magnum Bonum ...	95	170		6·3	14	2	5	2	48	204	4	8·2	14	14	2	16
Pioneer	90	159	1	6·4	13	4	4	16	34	210	5	8·8	13	14	1	18
Danish Variety 25 ...	173	72	0	2·9	12	8	8	14	166	97	1	3·7	14	12	9	4
Dreadnought ...	95	142	2	6·1	13	6	5	6	51	178	5	7·9	13	14	3	0

NOTE.—The above table gives the average results of three series in each of the two plots, the figures in each series being quite consistent.

tricts with a normal annual rainfall of 30 in. recording 8.9 in. in the month of July alone) the results were sufficiently promising to make a second trial advisable. It is the object of this article to discuss fully the results obtained in 1921.

1921 Trials.—In order to keep these trials within reasonable limits only four British varieties were tested, together with the two Danish strains which had proved most resistant to clubroot at Studsgaard and Herning in Denmark.

The seed of the former varieties was obtained from seedsmen in the ordinary way, whilst that of the Danish varieties was obtained from the experimental station at Herning through the courtesy of Mr. C. I. Christensen.

The trials were carried out on three farms in Carnarvonshire, viz. :—Dinas, Tregarth; Dolgynfydd, Carnarvon; and Pennarth, Clynnog. At each centre three series of plots were laid down, and in addition, each series was divided to allow of comparison of different treatments.

In this way eighteen series of plots were kept under observation, and a thorough check upon the results was obtained.

The swedes were sown on 13th May at Dinas, 30th May at Dolgynfydd, and 2nd June at Pennarth. A good and uniform plant was obtained at each centre, and considering the dry season the progress of the crops, except so far as they were affected by clubroot, was fairly good. The swedes were lifted at all the centres at the end of November.

Method of Examination and Stating Results.—The crop was examined in the field immediately after lifting, and before the roots were cleaned. Roots which showed no signs of disease, and those so slightly attacked that the diseased part would be removed in cleaning, were classed as *sound*. Roots so seriously affected that no cleaning could remove the whole of the diseased tissue, were classed as *bad*. The term *destroyed* was applied only to such useless roots as appeared to be destroyed by clubroot. The intensity of attack is shown in tables I and II by a figure calculated from the proportions of roots of these three classes in the crops. The figure "O" would signify that the crop contained none but sound roots, and is increased with the number of bad and destroyed roots up to 20, which would indicate a totally destroyed crop. This is a slight modification of the method used by Christensen.*

* Christensen, C. I., in Tidskrift for Planteavl: vol. xxvi, pt. I 1917 (abstract in Rept. of Int. Inst. of Agric. Rome, March 1918, p. 317).

The Tables show that at Dinas, the field was thoroughly and uniformly affected with the disease. At Pennarth and at Dolgynfydd the intensity of attack was not nearly so great, but they confirm the Dinas results very well. In every case the Danish varieties proved superior.

Table I gives in detail the results at Dinas, and clearly shows the great resistance of the Danish varieties as compared with the others. For instance, on the unlimed land the average intensity of attack of all the British varieties was 8.4, whereas the two Danish varieties suffered to the extent of only 4.9 and 3.7 respectively.

On the limed plots the difference was even more striking. Taking the last column but one there is little difference between the total weights per acre, but the last column shows that the Danish varieties gave a much better weight of *sound* roots than any of the other kinds tested.

TABLE II.—*Summary of Results three Centres.*

Average Intensity of Attack. Maximum = 20.

—	Dinas.		Dolgynfydd.		Pennarth.	
	Limed.	Unlimed	Slag.	Compound Manure.	Sulphate of Ammonia.	Super-phosphate.
	Average of 3 series.	Average of 3 series.	Average of 3 series.	Average of 3 series.	Average of 2 series.	Average of 2 series.
Lord Derby ...	6·	8·8	1·20	3·25	2·15	0·90
Danish Variety 5 ...	3·	4·9	0·4	0·93	0·84	0·50
Magnum Bonum ...	6·	8·2	1·3	3·70	0·95	0·84
Pioneer	6·	8·8	1·12	2·90	1·35	1·25
Danish Variety 25	2·	3·7	0·36	0·88	0·27	0·23
Dreadnought . .	6·	7·9	1·1	2·70	1·37	0·76

Effect of Treatment on Clubroot.—It will be seen from the Tables that in addition to the plots of the different varieties. cross plots were arranged and treated in different ways. Owing to some variation in the ground, and the difference in exposure to infection at Dolgynfydd and Pennarth, it is impossible to draw definite conclusions from the results at these two centres, but the different intensities of attack shown in the Dinas results may be taken as a fair indication of the effect of lime in preventing clubroot. The results are all the more striking on account of the fact that the lime was only applied shortly before sowing the seeds. If it had been applied in the previous year the chances are that its effect would have been even more marked.

Keeping Qualities.—In order to test the varieties still further at Dinas, all the roots of each variety from series 1 and 2 of the unlimed plots which were considered by the farmer to be sound enough for use, were clamped separately and left till 14th January, when they were again examined. Many of the swedes had rotted so completely as to be unfit for feeding to stock. These were discarded and the remainder were counted and weighed. The percentage losses in weight for the different varieties were found to be as follows:—Lord Derby 11.5; Magnum Bonum 15.6; Pioneer 20.4; Dreadnought 13.8; Danish Variety No. 4, 3.3; Danish Variety No. 25, 2.7. The two Danish varieties thus showed much better keeping powers than the rest.

Feeding Value.—Finally, it was desirable to determine the feeding value of the different varieties. This was done by obtaining the percentage of dry matter, the analyses being carried out by Mr. W. McLean, Lecturer in Agricultural Chemistry.

The results are as follows:—Lord Derby 8.3; Magnum Bonum 9.5; Pioneer 8.6; Dreadnought 8.7; Danish Variety No. 4, 10.0; Danish Variety No. 25, 10.0. The Danish varieties contained a higher percentage of dry matter than the other varieties tested. Since the feeding value of roots usually varies according to the proportion of dry matter, it is not unfair to assume that the two Danish varieties possessed a higher feeding value than the British varieties. It should be noted that previous experiments carried out by the University College, Bangor, have shown that roots grown in North Wales generally have a lower proportion of dry matter than the same varieties grown in some English districts.

General Conclusions.—It seems clear from the results obtained that two varieties have been found which resist clubroot to a marked degree, and in addition, keep better and have a higher feeding value than the remainder of the varieties included in the trial. This is the only conclusion one can arrive at even though reliable results are only available for one year, and that a relatively dry one in which the disease was less serious than usual.

An examination of Christensen's results shows that the Danish varieties exhibit an even higher degree of resistance in Denmark than they do in North Wales. In the present investigation Danish Variety 25 is consistently more resistant than Danish Variety 4. This is true of both the 1920 and 1921 trials, and is just the reverse of the results obtained by Christensen.

In assigning a value to the breeding of resistant strains it

should not be forgotten that at most it is a palliative, though it would seem that the growing of such strains will tend to starve out the fungus in the absence of susceptible weeds. The most certain way of eliminating the disease is to destroy the clubroot spores in the soil by the application of lime, and by prolonging the rotation. We do not, however, as yet know the minimum dressing of lime required for this purpose and, indeed, it is still uncertain what the effect upon the soil itself will be following the application of a given quantity of lime to any particular soil. For this reason as well as for other reasons previously discussed it is advisable to explore more fully the possibility of raising varieties of cruciferous crops resistant to clubroot.

Since these experiments were carried out Danish Variety 4 has been placed on the market and is obtainable from the firm Danske Landhoforeningers Froforsyning of Roskilde, Denmark, under the name "Studsgaard Bangholm." Possibly further selection from the point of view of resistance to clubroot may result in the production of a resistant strain of some well-known British variety.

Acknowledgment must be made of the great assistance rendered by Mr. Edwin Jones, B.Sc., a post-graduate student, in carrying out the trials here reported upon.

* * * * * *

A TRIAL OF TIMBER JACKS AND A MONKEY WINCH.

A REPORT* was recently published by the Ministry on hedge and stump clearing devices, containing the results of tests conducted at Long Sutton in Hampshire. An abstract of this report appeared in the Ministry's *Journal*, April, 1922, page 6. One of the devices tested was a mechanical jack, manufactured by Messrs. Trewhella Bros., of Birmingham, the results with which were far from satisfactory. Messrs. Trewhella therefore requested the Ministry to subject the device to a further trial, and with the concurrence of the Hampshire Agricultural Education Authorities advantage was taken of a test of sub-soiling and tillage machinery recently held at Sparsholt Agricultural Institute near Winchester, to obtain further data. Conditions were obtained as far as possible similar to those in the former trial at Long Sutton, and a monkey winch for timber removing manufactured by the same firm was also included in the test. Much better results were obtained in the later trial with the jack, and the device can be regarded as an economic unit worthy of consideration by any farmer desiring to clear timber over a protracted period.

The Test Ground.—The plot upon which the jacks and winch worked was level and consisted of light loam, with chalk at a depth of from 1 ft. to 1 ft. 6 in. In consequence all the timber was shallow rooted. The test lasted over a period of two days. During the first day, the monkey winch only was tested, and on the second day the jacks were tested. The timber consisted of elder, hazel and maple stools and blackthorn and maple trees.

Data were obtained under the following heads:—

1. Weight and volume of timber, size of crater, and quantity of earth displaced.
2. Number of hands required to operate the device.
3. Time taken to prepare for work.
4. Capital cost, depreciation, and maintenance.
5. Comparative degree of skill needed to work the device.
6. Mechanical design and construction, and general efficiency of the device.

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* Miscellaneous Publications No. 35. Price 2/6, post free, from the Ministry, 10, Whitehall Place, London, S.W.1.

7. Mechanical construction having regard to simplicity and access to wearing parts.
8. Method of extraction having regard to simplicity and safety.
9. Ease of handling, including manœuvring to the scene of operation.
10. Usefulness of the appliance for other work.

Description and Test.

Sale Price: March, 1922.

		£	s.	d.
A.	Ten-ton jack	13	10	0
	Five-ton jack	8	15	0
B.	Monkey winch (with stumping tackle)	57	0	0
	Monkey winch (without stumping tackle)	47	10	0

The Timber Jack.—The jack is of the well-known rack and bar type, the distinguishing feature being that the casing is made to move up and down the pillar instead of remaining stationary. This casing carries two lifting claws fitted at different heights, and on opposite sides, the top claw being at a convenient height to go under a load which the bottom claw has raised to its limit. To transfer the weight from the bottom to the top claw simply involves turning the pillar round.

The pillar of the jack consists of hard railway steel of great strength. Each jack is fitted with two spears of different lengths supported by guides, and by these the working range of the jack is considerably increased.

A simple device on the side of the casing releases the pawl action and thus permits the jack to be raised or lowered right up or down without working the handle.

To uproot a stump, a trench is dug on one side and the jack placed under a strong root. To prevent the base of the jack from sinking too far into the ground a steel base or a stout plank is placed underneath. Upon the lever being worked the jack rises and tears the stump bodily out of the ground.

Method of Trial.—Two men only worked on these machines and were equipped with grub axes, a spade and a crowbar. The jacks first worked approximately 1½ hours upon elder, hazel and maple and shallow-rooted stools. Considerable hand grubbing was done. It was observed that upon a stool being raised to a certain limit, the roots holding the stool to the ground were

cut and the extraction of the stool therefore presented no great difficulty. Following this, record was taken of the work of these jacks in extracting a blackthorn and a maple tree. These trees had an average diameter of about 10 in. and were shallow rooted. It was observed in this instance also that all roots were cut by means of the grub axe. Heavy rain fell while these trees were being extracted and hampered the work considerably.

Results.—

	Stools.		*Trees.*
Average diameter of stumps	18·5 in.	...	9·9 in.
Average time occupied in removing ...	9·61 mins.	...	30·5 mins.
Average cost per stump	4d.	...	12·75d.
Average cost per sq. ft. of cross section...	1·75d.	...	23·93d.
Average cost per cubic ft. of timber lifted	1·04d.	...	10·52d.

The Monkey Winch.—The mechanism of this machine does not depart greatly from the ordinary winch fitted with a ratchet gear, except that the steel rope is specially adapted for holding and pulling timber. The winch gear is fitted in a very compact steel frame, which can be moved from place to place on its own two wheels where the ground is not too rough. In other cases, two men can easily carry the machine from one spot to another.

The winch is fitted between trees or stumps by means of the steel ropes which are equipped with specially made couplings which wedge themselves on the rope, thus avoiding any possibility of slipping at high tension. By means of the single ratchet gear the load is applied by working a handle backwards and forwards which has the effect of winding in the rope and ultimately the strain becomes so great that the stump is torn from the ground.

Method of Trial.—Three men were allocated to the winch and were provided with grub axes, a spade and a crowbar. The stools in this plot consisted of elder and hazel and had very shallow roots. Little time was required for fixing the cable round the stool to be extracted, and the winch proved easily capable of extracting all stumps encountered. Owing to the radius within which this winch may work, it was found unnecessary to change the position of the machine.

Abstract of Results.—The results are as follows, details of which are given in the table on p. 372 :—

	Stools.
Average diameter of stump	23·3 in.
Average time occupied	5·8 mins.
Average cost per stump	3·6d.
Average cost per sq. ft. cross section...	1·1d.
Average cost per cubic ft. of timber lifted	·6d.

Observations on the Use of Each Device.—Both types of device were simple to operate and no difficulty was experienced in the test at Sparsholt. It may, however, be observed that before men can become skilled operators a certain amount of continuous practice is necessary. The mechanical construction of the machines is robust and simple and there appeared little likelihood of any defect occurring in the working parts. Both types of machines have been built to withstand excessive overloading. At no time was a very big load imposed on any of the devices, as the timber was all shallow rooted, whereas the timber in the test at Long Sutton was deep rooted. For this reason and the fact that the average diameter of the timber was smaller it is impossible to compare the results of the two tests. For similar conditions to those obtaining at Sparsholt the jacks can be regarded as very useful for land cleaning over a protracted period. The same remark applies to the monkey winch, though the usefulness of this device is greater than that of the jacks, because of its high load extraction capacity and the facility with which it can work in dense undergrowth.

	Jacks.		*Winch.*
	Stools or Coppice.	*Trees.*	*Stools or Coppice.*
Total number of stumps extracted ...	9	2	27
Diameter of stumps in inches—			
Smallest	12	9·5	12
Largest	27	10·3	43
Average	18·5	9·9	23·3
Number of working hours	1 hr. 26 m.	1 hr. 1 m.	2 hr. 37 m.
Average time per stump in min.—			
Grubbing	4·4	22·3	2·2
Extraction	5·2	8·3	3·6
Total	9·6	30·5	5·8
Average cost per stump	4·0d.	12·8d.	3·6d.
Cost per sq. ft. of cross section ..	1·7d.	23·9d.	1·1d.
Cost per cubic ft. of timber lifted ...	1·0d.	10·5d.	·6d.
Average volume of crater in cu. ft.	4·3	2·1	8·5

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NOTES ON FEEDING STUFFS FOR JULY.

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The Feeding Value of Milk By-products.—In the manufacture of butter, cheese and cream, a considerable amount of buttermilk, whey and separated milk is produced. These milk by-products are valuable feeding materials if rightly used with suitable meal mixtures. It is common practice on most farms where cheese, butter or cream is manufactured, to feed pigs with the milk residues, although there are still some places where the residues are thrown away as useless materials. A correspondent has recently asked for information on the feeding value of these by-products, and the following notes are appended in the hope that they may be of value to stock feeders accustomed to deal with such by-products.

Skim Milk.—On farms in favoured situations it is a common summer practice to sell cream and feed the skim milk. Skim milk is a highly nitrogenous feed, having a nutritive ratio of 1—1.5, and is of great value for building flesh and the bony framework of young animals. Experiments have shown that skim milk is more valuable than whole milk *per lb. of dry matter*. Skim milk is therefore of value for feeding to young growing livestock. For calves, it is possible to replace whole milk entirely at an age of from five to six weeks. For pigs, it is an excellent food at all ages. Danish experiments have shown that skim milk, potatoes, and mixed meals produce bacon of a high quality. Skim milk is best fed in conjunction with starchy foods, such as potatoes and maize meal. Compared with grain, 5 lb. of skim milk will replace 1 lb. of grain in feeding, and may be regarded as having equivalent feeding value. Skim milk and maize meal together form a good pig feed, although the inclusion of a little middlings or barley meal is beneficial, particularly where the production of first quality bacon is aimed at. In feeding meals with skim milk, the best proportion is at the rate of 1 lb. of meal to 3 lb. of skim milk. One last point, skim milk produces costiveness, and the meals fed with it should possess the opposite tendency.

Whey.—Whey consists chiefly of milk albumen, milk sugar, and mineral substances. Unlike skim milk, it has a somewhat

DESCRIPTION.	Price per Qr.		Price per Ton.	Manurial Value per Ton.	Cost of Food Value per Ton.	Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv.	Price per lb. Starch Equiv.
	s.	lb.	£ s.	£ s.	£ s.		s.	d.
Wheat, British	58/–	504	12 18	1 0	11 18	71·6	3/4	1·78
Barley, English Feeding	39/–	400	10 18	0 18	10 0	71	2/10	1·52
„ Canadian No. 2 Feed	34/–	400	9 10	0 18	8 12	71	2/5	1·29
Oats, English White	38/–	336	12 13	0 19	11 14	59·5	3/11	2·10
„ „ Black & Grey	36/–	336	12 0	0 19	11 1	59·5	3/9	2·01
„ Canadian No. 2 Feed	29/9	320	10 8	0 19	9 9	59·5	3/2	1·70
„ Argentine	27/6	320	9 12	0 19	8 13	59·5	2/11	1·56
Maize, „	38/6	480	9 0	0 17	8 3	81	2/–	1·07
„ South African	37/–	480	8 13	0 17	7 16	81	1/11	1·03
„ American	35/–	480	8 3	0 17	7 6	81	1/10	0·98
Beans, English Winter	61/3*	532	12 18	1 15	11 3	67	3/4	1·78
„ Rangoon	—	—	8 0	1 15	6 5	67	1/10	0·98
Buckwheat, Manchurian	51/–	392	14 11	1 6	13 5	53·4	5/–	2·68
Millers' offals—								
Bran	—	—	6 10	1 16	4 14	45	2/1	1·12
Broad Bran	—	—	8 10	1 16	6 14	45	3/–	1·61
Fine middlings (Imported)	—	—	9 15	1 7	8 8	72	2/4	1·25
Coarse middlings	—	—	9 5	1 7	7 18	64	2/6	1·34
Pollards (Imported)	—	—	7 17	1 15	6 2	60	2/–	1·07
Rice Bran	—	—	7 10	—	—	—	—	—
Barley Meal	—	—	11 10	0 18	10 12	71	3/–	1·61
Maize „ S. African	—	—	8 15*	0 17	7 18	81	1/11	1·03
„ Germ Meal	—	—	8 17	1 5	7 12	85·3	1/9	0·94
„ Gluten-feed	—	—	8 17	1 11	7 6	75·6	1/11	1·03
Locust Bean Meal	—	—	9 0	0 9	8 11	71·4	2/5	1·29
Bean Meal	—	—	13 10	1 15	11 15	67	3/6	1·87
Fish „	—	—	15 5	5 10	9 15	53	3/8	1·96
Linseed	—	—	22 0	1 16	20 4	119	3/5	1·83
„ Cake, English (9% oil)	—	—	13 5	2 6	10 19	74	2/11	1·56
Cotton seed „ English (5% oil)	—	—	8 10	2 6	6 4	42	2/11	1·56
„ „ Egyptian (5% oil)	—	—	8 5	2 6	5 19	42	2/10	1·52
Soya Bean Cake (6% oil)	—	—	11 10	3 3	8 7	69	2/5	1·29
Coconut Cake (6% oil)	—	—	9 15	1 19	7 16	73	2/2	1·16
Groundnut „ (6% oil)	—	—	9 7	3 5	6 2	47	2/7	1·38
Palm kernel Cake (6% oil)	—	—	7 5*	1 9	5 16	75	1/7	0·84
„ „ Meal (2% oil)	—	—	6 5	1 9	4 16	71·3	1/4	0·71
Feeding Treacle	—	—	4 15	1 1	3 14	51	1/5	0·76
Brewers' grains, dried, ale	—	—	7 12	1 11	6 1	49	2/6	1·34
„ „ „ porter	—	—	6 15	1 11	5 4	49	2/1	1·12
„ „ wet, ale	—	—	1 0	0 8	0 12	15	–/10	0·45
„ „ wet, porter	—	—	0 16	0 8	0 8	15	–/6	0·27
Malt culms	—	—	8 0*	2 3	5 17	43	2/9	1·47

* Prices at Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of May and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 9s. per ton. The food value per ton is therefore £8 11s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 3d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·21d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

wide nutritive ratio, and therefore requires feeding with foods rich in protein, as, for instance, linseed meal and wheat middlings. Where the meals available on the farm are of a starchy character, the introduction of a little earth-nut cake, pea meal or bean meal will be of value. For feeding to pigs, whey has about half the feeding value of skim milk, *i.e.*, 10 lb. of whey equals about 5 lb. of skim milk. Whey is laxative in character and should be fed with foods producing the opposite effect.

Buttermilk.—Buttermilk has substantially the same value for pigs as skim milk, and the remarks as to the value of skim milk apply generally to buttermilk, except perhaps with regard to calves. Buttermilk has been used successfully with calves, but cannot be generally recommended except in cases where scrupulous cleanliness prevails. Unless such conditions exist, fermentation sets up in the buttermilk, and a comparatively harmless and useful feeding stuff then becomes dangerous.

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Goat-keeping in British Columbia.

THE Department of Agriculture for British Columbia has recently issued a third edition of its Bulletin No. 64, entitled "Goat-raising in British Columbia." The place of the milch goat in the Province is now well established, and what was at one time considered a passing fad is looked upon as a profitable and useful branch of the live stock industry.

The chief place of the milch goat in the Province is as a provider of wholesome milk for the household at a moderate cost, but it is considered that there is money to be made from the regular supply of goats' milk to large cities owing to the well-known pre-eminence of this milk as the best form of nutriment for infants and invalids, as a result of which it commands a ready sale at double the price of cows' milk.

Under the rules of registration of the Canadian Goat Society, it is interesting to note that in the case of British milch goats, Toggenburgs, and Nubians, animals are admitted for registration if they have already been registered in the British Goat Society's Herd Book.

The Bulletin gives valuable information on the housing, feeding and general management of goats. It also describes methods of making goats' milk into butter and cheese and deals with the utilisation of goat flesh for the table. It is stated that goat's milk has been known for centuries as an ideal food for infants and invalids, because of its easy digestibility, and many hospitals and sanatoria keep herds to supply milk for their patients. Though

rich in butter-fat, generally averaging about 5 per cent., the milk does not form heavy curds in the stomach; the curd from goats' milk is light and flaky and digests in about one-third the time of that of cows' milk.

A special section of the Bulletin is devoted to the breeding of Angora goats, some fine illustrations of these animals being given. The cheaper grades of this breed are kept largely in the United States, primarily for keeping down brushwood growth. The goats are turned out on to the brush and kill off all but the larger saplings by persistent browsing on the foliage and bark, and thus convert the useless brush into mohair and goat flesh. Angora goats which are nearly pure bred are stated to produce a fleece of about 3 lb. to 5 lb., and the price of mohair has been steadily rising of late years. Angora hides of the best quality are made into morocco leather for books, while the poorer quality make workmen's gloves. Angora pelts are in demand for robes, for baby-carriages and children's cloaks, and for house-rugs They are worth from 2 to 3 dollars each.

(The Ministry of Agriculture and Fisheries has published the following leaflets on goat-keeping, copies of which may be obtained from the Ministry's offices, 10, Whitehall Place, London, S.W.1, price 1d. each:—No. 306, The Goat as a Source of Milk; No. 383, Hints on Goat-keeping.)

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Road Regulations for Agricultural Tractors.

FARMERS who own agricultural tractors would be well advised to make themselves acquainted with the recommendations contained in the Second Interim Report of the Departmental Committee on the Taxation and Regulation of Road Vehicles with regard to the use of tractors on highways. The Committee point out that the introduction of tractors is comparatively recent and consequently the regulations governing the use of mechanically-propelled vehicles are not always applicable. In many cases the use of these tractors on roads is believed to be illegal, and the Committee consider that the time has arrived when special regulations should be made to regularise and legalise this type of vehicle. At the same time, it is necessary to provide for the safety of the public, and to ensure that the risk of damage to the roads is reduced to a minimum.

The principal recommendations of the Committee are as follows:—

(i) An agricultural tractor is defined as "a mechanically-propelled vehicle constructed and used for agricultural purposes not exceeding $3\frac{1}{2}$ tons in weight unladen, and drawing, but not itself carrying, any load except such as is necessary for its propulsion and use."

(ii) The sum of the axle weights of an agricultural tractor and any trailer drawn by it should not exceed 8 tons.

(iii) The speed of agricultural tractors on a public highway should be limited to four miles per hour, unless the tractor complies strictly with the Regulations governing any other class of vehicle, in which case it might proceed at the speed appropriate to that class, subject to a maximum of 16 miles per hour.

(iv) Agricultural tractors should not be required to be constructed with springs between any axle and the frame.

(v) The steering wheels of an agricultural tractor should, when used on roads, be fitted with a band which should be smooth, and, where the tyre touches the surface of the road, flat and not less than 2½ inches in width.

(vi) The driving wheels of an agricultural tractor should be not less than 36 inches in diameter, and wheels, other than driving wheels, not less than 24 inches in diameter; it is recommended that this provision should not apply in the case of tractors weighing 15 cwt. or less unladen, or in the case of the trailing wheels of self-contained motor ploughs. This provision it is proposed should not come into operation until 1st April, 1923.

(vii) All agricultural tractors should be fitted with two brakes, with the exception of:—

(*a*) Tractors under 20 cwt. in weight, used exclusively for hauling agricultural implements and agricultural machinery;

(*b*) Tractors of the "caterpillar" type up to 30 cwt. in weight, used exclusively for hauling agricultural implements and agricultural machinery.

(*c*) (*Up to 1st April*, 1923) tractors between 20 cwt. and 30 cwt. in weight used exclusively for hauling agricultural implements and agricultural machinery.

In these cases one brake only, it is considered, need be fitted.

(viii) One identification plate only should be required on agricultural tractors used exclusively for hauling agricultural implements and agricultural machinery, such plate to be affixed in front of the tractor.

(ix) Driving wheels of agricultural tractors used exclusively for hauling agricultural implements and agricultural machinery should, as regards their tread, be either smooth and flat, or flat but fitted with diagonal crossbars of not less than 3 inches in width nor more than ¾ inch in thickness, extending the full width of the tyre, provided that the space intervening between each pair of crossbars should not exceed 3 inches. The crossbars should be so disposed throughout the tyre that the aggregate extent of the crossbars or crossbar in the course of a straight line drawn horizontally across the circumference of the wheel would nowhere be less than half the width of the tyre. The width of the driving wheels should be such as to allow no greater load per inch width of wheel than 3 cwt.

(x) Agricultural tractors of the "caterpillar" type should be legalised for the same purposes as wheeled tractors, provided that those parts of the track which are in contact with the ground are either flat or rounded and have a minimum width or diameter of ½ inch. The total area of the

track actually in contact with the ground should be not less than 36 square inches in respect of each ton of the unladen weight of the tractor.

(xi) An agricultural tractor should be permitted to draw only one trailer but no trailer should be drawn when the tractor is drawing agricultural machinery or agricultural implements running on their own wheels.

(xii) It is not proposed that Paragraphs (v), (vi), (vii), (ix), (x), (xi) above should apply in the case of agricultural tractors not exceeding 10 cwt. in weight unladen.

It is understood that an Order based upon these recommendations will be issued shortly by the Minister of Transport. The practical effect will be that owners of tractors will by the dates laid down in the Order (not necessarily those recommended by the Committee) have to ensure that their tractors *when travelling on the road* are properly equipped. The provisions entailing most trouble to farmers to be included in the Order if the recommendations of the Committee are adopted, are those relating to steering wheels and brakes. Where the steering wheels have a non-detachable sharp projecting flange, it will presumably be necessary to fit bands which will make the surface flush; in point of fact an owner who at present permits any such tractor to be driven on the highway runs a very serious risk, and the recommendation is in accordance with the precautions at present taken by reasonable users of the road. It will not be disputed that the brakes required by the Committee are for the safety both of the driver and other users of the highway.

It is to be anticipated that tractors in future placed upon the market will comply strictly with any Order that may be issued, and any inconvenience which it may cause will be limited to the transition period when owners are under the necessity of adapting their machines to the new requirements.

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Covers for Corn Stooks and Hay Cocks.

IN view of the difficulty of successfully harvesting corn and hay (particularly clover, lucerne, tares, etc.) in wet weather, the Ministry in 1920 had small tests carried out with a device for covering corn stooks, and in 1921 both corn stooks and hay cocks.

1920 Trials.—*Description of Covers.*—The covers tested in 1920 were of semi-glazed heavy paper, which was claimed to be water proof, and they were six feet in length, and in the shape of a cottage roof. They were intended to cover and protect from rain and birds stooks of from 10 to 12 sheaves each. The

fasteners consisted of cord (two pieces on each cover) which were fastened through eyelets on one side of the cover, and when adjusted were threaded through the stook by means of a long steel needle and fastened to eyelets on the opposite side of the cover.

The trials were carried out in 1920 at Cambridge University, Armstrong College (Newcastle-on-Tyne), Leeds University, Aberystwyth Plant Breeding Station, Newton Rigg Farm School (Westmorland), and in the counties of Derby, Cornwall, and Cardigan.

Durability of Covers.—The covers stood rain well at Cambridge, Leeds, Cardigan and Cornwall. Conditions seem to have been more adverse at Armstrong College, Aberystwyth, Newton Rigg, and Derby. More damage was apparently caused by high wind than by rain. At Armstrong College four weeks of bad weather rotted and tore the covers, at Aberystwyth 70-80 per cent. were broken after a week of unsettled weather, in Derby some were ripped by the wind, while at Newton Rigg the trial covers withstood heavy rain but some were torn by high winds.

The result of the trials seemed to show that if the covers were used in districts where the heaviest weather is experienced they must be made of more durable material.

Efficacy and Special Uses.—At Cambridge the rain passed off the covers and the corn beneath dried continuously though rather more slowly than that which was not covered. At Leeds rain followed the cutting of the barley so that the corn was wet when stooked. Unfavourable drying conditions followed, and when stacked the moisture content of the covered corn was found to be higher than that of the uncovered. At Aberystwyth the covers that withstood the wet spell kept the stooks in very good condition, provided they had been covered when the sheaves were dry. Stooks that were covered when damp were in a poor condition when the covers were removed.

In Derby the covers kept the oats dry, and, when taken off, the oats were very clean and bright. In Cornwall the oats under the covers were in splendid condition and the covers were stated to provide protection against wood pigeons and to be useful, therefore, in positions adjoining woods.

It appeared that in Cardigan, Derby and Cumberland the covers would have to meet the competition of local methods of covering stooks. In Derby and Cumberland it is usual to place hooding sheaves on the top of the stook to act as cover.

Labour and Cost.—At 1s. apiece the cost of covers alone is about £3—£4 per acre, and the cost of labour in fixing and unfixing has to be added to this. As regards extra labour required, at Aberystwyth it was found to take two men about two minutes to cover one stook, or about two to three hours to cover one acre. On account of the expense of covers and labour the practice was not considered economical at Cambridge and at Armstrong College, and the extra labour was stated to be an important item at Newton Rigg and in Cornwall.

1921 Trials.—As a result of the 1920 trials the manufacturers of the covers used for the 1921 season stronger paper and dispensed with the arrangement for threading them together with needles, using instead better twine, attached to the eyelet holes, for tying to the sheaf bands. 5,000 covers for corn stooks and 5,000 for hay cocks were supplied free of charge and distributed to 48 different centres in England and Wales by arrangement with the Ministry. Owing, however, to the exceptionally dry weather experienced, 23 of the centres were unable to use the covers.

Durability.—It was again found at a number of centres that the covers did not stand strong wind, especially after rain. At other centres, however, they were stated to be quite fit to use again.

Effectiveness.—Protection from damage by birds was reported from the Oxford School of Rural Economy, Cumberland and Westmorland Farm School, Worcestershire, Cornwall and Cheshire. Prevention of sprouting in stooks was reported from Cumberland, Staffordshire, and Cornwall, while in Staffordshire, Worcester, Cornwall, Bangor, and Denbigh grain and straw from covered stooks appeared to be freer from stain, and brighter and sweeter in smell than that from uncovered stooks.

From Worcester and Cornwall it was reported that the covers would be suitable for special seed crops. At Armstrong College the covers saved oats which were out in bad weather for five weeks. The report from Montgomery stated that the covers would be very valuable in a wet season. Rothamsted Experimental Station stated that stooks sink after making and leave the covers loose and liable to damage by wind, while covered barley did not bleach so well as uncovered. In E. Suffolk the covers were found to prevent hay from drying.

Summary.—The exceptionally dry weather which was experienced in 1921 did not allow of a fair test as to the strength of the covers when subjected to heavy rain, but it appears that,

although they stand the rain well, they will need to be made of a stronger material (especially at the corners where the strings are attached) to be of use in wet and windy weather. They should also be made a little larger so as to come below the bands of the sheaves.

As a protection against birds the covers are very useful, while grain and straw from covered stooks appear to be freer from stain, brighter, and sweeter in smell than those from uncovered stooks. The covers also prevent sprouting in stook.

They would obviously be useful in the case of special crops, such as pedigree corn, where protection from birds and prevention of darkening by bad weather is more than usually necessary.

At 1s. each. the initial cost of the covers, which should last with ordinary use two seasons, is about £3—£4 per acre, while the extra cost of fixing averaged about 2s. per acre.

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Live Stock Importation Regulations.

A SUMMARY of the general regulations governing the importation of Live Stock into the British Dominions, Colonies and Protectorates, and into foreign countries, has been prepared by the Ministry for Departmental use. It is, however, thought that copies of this summary may be of service to exporters, and typed copies are obtainable at the Ministry's Offices, 10, Whitehall Place, London, S.W.1, price 10s. each. A copy of the summary relating to any particular country for which the regulations are available will be supplied free.

The information given in the summary is an indication of the general regulations (apart from temporary prohibitions) of the various countries on the importation of stock from Great Britain and Ireland, as far as they are at present available. Purchasers will be informed of any amendments made in 1922 to this summary in the case of the more important countries. From 1923 onwards a charge, to be notified later, will be made for supplying such amendments.

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NOTICES OF BOOKS.

British Goat Society's Year Book, 1922.—(Compiled and issued by the Hon Secretary, Thomas W. Palmer, 5, Fenchurch Street, London, E.C.3. Price 1s. 6d.) The second issue of the British Goat Society's Year Book contains much information which should prove useful and interesting both to goat keepers and to many who may consider the keeping of goats.

The Society has been in existence for many years and has done much to assist the development of goat keeping and to further the interests of goat keepers in Great Britain and Ireland. The objects of the Society are stated to be :—

(*a*) To circulate knowledge and general information upon goats with a view to counteracting the prejudices and ignorance which prevail in a great degree concerning these animals.

(*b*) To extend and encourage the keeping of goats, particularly by cottagers, so as to increase the supply and consumption of milk in rural districts where this article is frequently unobtainable.

(*c*) To improve the various breeds of goats and specially to develop those qualities which are generally recognised and valued in milch stock.

The Society, which now consists of several thousand members, has for many years carried on an active campaign in favour of the goat, and it is due to the Society that any reliable pedigrees and records of the milking qualities of goats in this country are available. Such importations of foreign blood as have been made from time to time in the past with the object of improving the quality of British goats have been due mainly, if not entirely, to the British Goat Society, and it is to its efforts and the work of its affiliated societies that goat shows and classes for goats at agricultural shows have been organised on more extensive lines. The milking trials held under the regulations of the British Goat Society and the distinguishing descriptions awarded to good milkers and their progeny under the Society's regulations have done much to improve the milking qualities of British goats.

Mr. Reginald Pease, Chairman of the Committee, states that "during the past year a few animals were exported to some of our colonies and elsewhere and there is no reason why a lucrative and much larger trade should not be done in this direction."

An article is contributed by Mr. Arthur W. Abbey, entitled "The Goat and Agriculture," in which he gives his experiences of the value of the goat as an agent in the improvement of pasture land.

In an article on Goat's Milk, Doctor B. D. Z. Wright states that many infants suffering from what is commonly called "marasmus" have been saved by goat's milk, and that many more might be saved if they had the chance of being reared on goat's milk instead of tinned condensed and dried substitutes for mothers' milk. He also refers to the freedom of goat's milk from tubercle bacilli as an enormous asset.

An article on goat keeping in Holland by Mr. P. A. Francis gives a brief description of the remarkable development of goat keeping in Holland during recent years. The fact that according to official figures there were in the

year 1900 some 224,231 goats in the Netherlands is significant when it is borne in mind that dairy cattle are also kept in large numbers in that country.

Holland possesses perhaps the only Goat Breeding Experiment Station in the world. This Station was established through the generosity of a private individual, but the Station is stated to be now maintained by subscriptions from the provincial Unions, by grants from Local Authorities and from the Government.

Productive Swine Husbandry.—(George E. Day, London and New York; J. B. Lippincott Company; price 10s. 6d. net.) This volume is a third and revised edition and forms one of the series of Farm Manuals published by the J. B. Lippincott Company. As "review questions" are given at the end of each chapter, it may be surmised that the author had specially in view the needs and instruction of farm students. Productive Swine Husbandry, with its chapter on suggestions to beginners, is eminently suitable to farm students as well as to those who are already engaged in the breeding of pigs and the production of pork. The illustrations (ninety-five) are well reproduced and should be of great assistance to the reader.

One of the early chapters is devoted to a description of the two types of swine, the lard type and the bacon type—divisions which appear to have been considered to a greater extent in the United States than in this country, and in the near future will receive still greater consideration if the pork packers persist in their endeavour to pay far greater attention to the requirements of the British market for pork and bacon, and the produce of pigs of the bacon type which have not been fattened mainly on maize.

A considerable amount of space has been devoted to descriptions and histories of the various breeds of swine which have originated in the United States and in this country. The former appear to be clear and complete, although the scales of points show quite a number of variations from similar ones adopted in England. In the Poland China score card, twelve points are allotted to chest, fourteen to back and loin, ten to sides and ribs, ten to ham and rump, and ten to feet and legs. Action and style, condition, disposition and symmetry of points, together claim ten points. The American breeds described include the following:—Poland China, Chester white, Duroc Jersey, Thin Rind, or Hampshire, Victoria, Cheshire, Essex, Suffolk and Mule Foot. The descriptions of the British breeds are not so complete and refer to large Yorkshires or Large Whites, Tamworths, Small Yorkshires, or Small Whites, and of two so-called minor breeds, Large Blacks and Middle Whites. Probably the cause for this last is that in Canada particularly the two latter breeds are little known. Further, the fact that in this country these two breeds have enormously increased in popularity of late years does not appear to have been realised on the American Continent. The Cumberland, Gloucester Spots, Lincolnshire Curly Coat, Essex or Wessex Saddleback are not described.

The chapters on selection of bear and sow, on breeding, feeding and fattening are very complete, and a considerable number of experiments are described, many of which are acknowledged to be from Henry's admirable work on "Feeds and Feeding." The various systems of pig-keeping are fully given, with illustrations of piggeries varying from large and permanent buildings to the small movable pen, which is freely utilised in small enclosures

where open-air pig keeping has been carried on extensively for at least two or three decades. The chapter on suggestions to beginners is short, but is full of good advice. To complete a most useful and instructive volume a chapter is added on the diseases of swine.

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Foot-and-Mouth Disease.—Since the 21st May, the date of the note contained in the *Journal* for June, 1922, page 286, only 22 outbreaks of Foot-and-Mouth Disease have been confirmed in Great Britain, bringing the total up to the 22nd June, 1922, to 1,121, of which 1,016 were in England, 3 in Wales, and 102 in Scotland. Of these 22 outbreaks, 5 occurred in Derbyshire, 8 in Lancashire, 1 in Nottinghamshire, 2 in Staffordshire, 3 in Warwickshire, 1 in Worcestershire, 1 in Cheshire and 1 in Northumberland. As most of the districts had been freed from the Foot-and-Mouth Disease restrictions in force earlier in the year, all except the outbreak in Staffordshire occurred in free districts, and necessitated the re-imposition of Orders controlling the movement of animals over considerable areas around Chesterfield and Bakewell (Derbyshire), Birmingham, and Rochdale (Lancs.), Holmeschapel Crewe, in Cheshire, and Ponteland, near Newcastle, Northumberland. The Scheduled District round Rochdale had to be extended westwards on account of outbreaks at Westhoughton on 20th June, and near Liverpool on 22nd June. The outbreak in Nottinghamshire involved a small extension of the Scheduled Area in that county. All the 22 outbreaks above mentioned were dealt with by slaughter of the affected animals and of the animals in direct contact with them, involving the slaughter of a total of 346 cattle, 100 sheep and 301 pigs.

During the period under review, the restrictions were withdrawn entirely from the remaining Scheduled Areas in Midlothian, Forfarshire, Renfrewshire, Dumbartonshire, Durham, Leicestershire, and the 3 Ridings of Yorkshire (except a small portion of the West Riding, forming part of the new Rochdale Scheduled District). In addition the area in Berwickshire has been considerably reduced.

The origin of the disease at the new centres in Derbyshire, Warwickshire, Lancashire, Cheshire and Northumberland is unknown, and it is possible that infection from previous outbreaks may still be lurking in railway trucks used for stock. Having this in mind the Ministry has issued a circular letter to all railway companies asking them to give instructions for a special and thorough cleansing of all railway trucks used for the conveyance of animals in order that this source of infection may be destroyed, and Local Authorities have been asked to keep special observation over the manner in which the cleansing and disinfection of railway vehicles and railway pens used for stock is carried out. It is also necessary that farmers should remain constantly on the watch for any symptoms amongst their stock suggesting the presence of Foot-and-Mouth Disease, and should report such cases immediately to the police.

Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE,
By Metchim & Son, Princes Street, Westminster, S.W.1.

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXIX. No. 5.

AUGUST, 1922

NOTES FOR THE MONTH.

Honorary Degrees for Agriculturists.

THE ceremony of the conferring of honorary degrees at Cambridge is always interesting. The historic Senate House, the dignity of the proceedings, and the unfamiliar tongue in which they are conducted, the black or scarlet gowns of the University potentates culminating in the black and gold of the "most illustrious Chancellor," above all the eminence of the men who are there to receive honour from a great man, the chosen head and representative of a great University—all these combine to impress the most casual visitor.

But this year everyone who is concerned with agriculture must have felt a special interest in the proceedings; for six out of the nine who received honorary degrees on the 6th July, were men whose names are known throughout this country and beyond it because of their services to that great industry. They were Mr. C. R. W. Adeane, Sir Gilbert Greenall, Sir Daniel Hall, Mr. E. S. Beaven, Mr. A. E. Humphries and Mr. Ernest Mathews.

It is the practice for the Public Orator of the University in presenting to the Chancellor (at present the Earl of Balfour) each recipient of an honorary degree, to make a short speech describing the activities, virtues and services of the candidate —whose blushes are spared (unless he happens to retain a good share of youthful acquirements) because the speech is involved in the decent obscurity of a dead language. In the present case some account of these brief biographies may be interesting to readers of the *Journal.*

Mr. C. R. W. Adeane, the Public Orator said, is familiar to Cambridgeshire, of which he is Lord Lieutenant: he is

known far outside the county as a famous breeder of pedigree sheep and shorthorns (" cows adorned with a somewhat short horn "). A visit to the Royal Show will prove his skill and industry. The Royal Agricultural Society can testify to his financial powers.

Sir Gilbert Greenall was described as one who had learned his philosophy from life itself; a union of farmer and sportsman, the greatest judge of horses and cattle in England. He has found the way to combine fertility and amenity on his estates; and, finally, he is known as the autocrat of the Royal Agricultural Society's Show, to whose sway all bow.

Of Sir Daniel Hall the Public Orator first spoke as one of the Development Commissioners, to whom 13 years ago the Chancellor of the Exchequer entrusted the spending of " immense sums " for the benefit of agriculture. He administers all agricultural research whether in the field or in the laboratory. He has an unequalled knowledge of the past history and present uses of the countryside, its roads, villages and various districts. If you seek a proof, read the book which " this second Cobbett " has written on his pilgrimage through Britain. He is an eloquent speaker, a great gardener and lover of tulips, besides a keen collector of Japanese prints and Chinese pottery.

Mr. E. S. Beaven appeared in the Public Orator's speech as the apostle of self-reliance. He has produced and made known to this country two new kinds of barley. He is a king among barley cultivators, farmers, and professors alike. Whatever his hand finds to do, he does it with all his might, whether it be the sowing of barley or the driving of a motor-car.

The services of Mr. A. E. Humphries and his association with Professor Biffen in the improvement of wheat formed the main subject of the Public Orator's speech in presenting him to the Chancellor. Mr. Humphries has proved that Canadian wheat can be grown in this country, and if mixed with our own wheat, improves the quality of the bread. He has investigated the construction of mills, and devised improvements of machinery: he is a firm believer in the power of science to promote human progress.

Mr. Ernest Mathews was presented as equalling the Latin poet in his love of cattle, and far surpassing him in knowledge. " He has taught us the value of a certain kind of island cow." He claims as his province everything which comes from milk. He is an investigator and inventor in all the arts of separating

cream, of butter making and of cheese making. There is another art dear to the shepherds and cowherds of Virgil which he has not neglected, for he is a great lover of music.

Even these brief extracts from the Public Orator's remarks will convince our readers that the recipients of Honorary Degrees are to be congratulated not only on the honour done to them but on the felicitous eulogies with which that honour was accompanied. All agriculturists will join in these congratulations, and recognize the justice of the eulogies.

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Importation of Canadian Store Cattle.

THE long anticipated debate in the House of Commons on the subject of the exclusion of Canadian store cattle under the Act of 1896 took place on 24th July, the decision being left to the free vote of the House without any official intervention on the part of the Government. The question was raised on the following motion put down by Mr. Shaw:—

> "That this House is of the opinion that the time has arrived when the embargo on the importation of Canadian cattle should be removed,"

and a considerable number of Members of all parties spoke both for and against the motion.

The Minister of Agriculture, Sir Arthur G. Boscawen, spoke strongly in favour of the retention of the Act of 1896. The voting was ultimately, however, in support of the motion, which was carried by 247 votes to 171, a majority of 76.

* * * * * *

Harvest Weather Forecasts.

THE Meteorological Office will supply farmers with the following two classes of weather forecasts which are of special value at harvest time:—

Regular Forecasts.—These are for the farmer who wants to keep an eye on the weather more or less every day. He can get them telegraphed in the early morning, in the middle of the day, or about tea-time. They cover the next 24 hours. *No charge* to registered recipients (Registration fee 1s.) except the Post Office charge for telegraphy.

Spells of Settled Weather.—Whenever a few days' settled weather is seen approaching a message is sent out informing

subscribers of the fact. A small charge of 6d. per message is made in this case in addition to the cost of the telegram.

Fuller particulars will be supplied on application, but forecasts will commence on receipt of a note addressed to the Director of the Meteorological Office, and a sum either in the form of a deposit of 7s. 6d. or sufficient to cover the total cost of the messages asked for.

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Conciliation Committees in Agriculture.

THE total number of agreements in operation at the present time is 45, which is the largest number at any one time since the Committees were set up.

The Committee for Carnarvonshire has reached an agreement covering the hiring period up to 13th November for a rate for adult special class workers of 21s. per week (of 61 hours up to 30th September and of 58 hours for the remainder of the period) plus the provision of board and lodging (estimated in the case of such workers as being equivalent to 12s. 6d. per week), and of 32s. per week (of 52 hours) for other adult male workers. The Derbyshire Committee has decided to extend its agreement, which was due to expire in June, up to the end of September, the rates for adult male workers being 7½d. per hour for weekday employment and 10d. per hour on Sundays.

Several Committees have had under consideration the question of harvest rates, and agreements have already been reached in the East Riding of Yorkshire, in Anglesey and in Essex, and agreements in other areas where this question is of importance are anticipated shortly. The East Riding Committee has agreed that for haytime overtime shall be paid at the rate of 1s. per hour for all time worked over the normal hours in actual operation on individual farms. This Committee has further agreed that the minimum rate of harvest wages for weekly workers (exclusive of horse lads who are not in receipt of overtime pay for attending horses) shall be a fixed rate of £3 per week for a harvest of 4 weeks, the hours to extend to 7 p.m. during cutting and 8 p.m. when leading, and up to 6 p.m. on Saturdays throughout: after 4 weeks harvesting minimum wages to be at the ordinary rate and ordinary overtime, *i.e.*, time and a quarter. As an alternative the Committee has agreed on the payment of the ordinary rate with overtime at the rate of 1s. 6d. per hour during harvest operations.

The terms of the Anglesey Committee's agreement provide that during the hay and corn harvest, adult male workers shall be paid at not less than 30s. plus board for a week of 56 hours.

Under the agreement of the Essex Committee the harvest wages will be as follows:—

1.—(*a*) $7\frac{1}{2}$d. per hour for 50 hours per week to be paid where possible on a Friday, plus a bonus of £4 10s.; the bonus to be paid on completion of harvest. If part time only is worked in the harvest a proportion of this bonus to be paid. Alternatively (*b*) a rate of 9d. per hour to be paid for all time worked at harvest work where this system is preferred.

2.—These agreements do not prejudice the piece-work system of harvesting so long as the rates paid are not less than the above.

3.—The hours to average $11\frac{1}{2}$ per day, and when possible leaving-off time to be one hour earlier on Saturdays.

4.—In cases where an amicable interpretation of the agreement cannot be arrived at, the matter should be referred to the Conciliation Committee for their consideration.

Particulars of the agreements in any area can be obtained on application to the Ministry.

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The Agricultural Index Number.

THE prices of practically all kinds of agricultural produce are liable to seasonal variations, and this is especially the case with products such as eggs and milk which fall in the spring as larger supplies come on the market, and rise again as the season advances when supplies become more restricted. Wheat is often affected by the large supplies which are put on the market after the crop is harvested, and barley is affected by the larger quantities of malting quality sold in the autumn. In attempting a comparison of the changes from month to month the seasonal variations must be taken into account, and with this object the monthly index numbers given below are based on the average prices of the same products in the same months of the three years 1911-13. The figures show that the average prices of farm products generally during June were 68 per cent. above those ruling in June, 1911-13. By this arrangement seasonal

fluctuations which are more or less normal to the time of year are practically eliminated. Hitherto the monthly index number has been based on the average prices of the three years, 1911-13. The actual difference is not great in practice, but the present system shows the price changes more accurately.

	Percentage Increase as compared with the average prices ruling in the same months of 1911–13.	
	1921.	1922.
January	183	... 75
February	167	... 79
March	150	... 77
April	149	... 70
May	119	... 71
June	112	... 68

The June figures show on the whole a slight reduction from those of May. This is attributable principally to the recent decline in the value of fat sheep and potatoes, both of which reached a very high point in May but have since declined considerably. Other changes during June were comparatively slight.

The changes which have taken place during the past six months are, however, rather striking in the case of several commodities, as will be seen in the following table which is calculated on the same basis as that referred to above :—

	Percentage Increase as compared with the average prices ruling in the same months of 1911–13.					
	Jan.	Feb.	Mar.	Apr.	May	June
Wheat	44	50	66	57	62	60
Barley	51	49	46	49	49	58
Oats	49	48	53	49	53	57
Fat cattle	62	67	66	65	70	71
Fat sheep	60	72	100	128	140	121
Fat pigs	71	82	85	90	91	82
Eggs	114	166	95	89	50	69
Poultry	76	80	77	83	110	116
Milk	125	117	92	42	27	28
Butter	46	41	37	49	54	59
Cheese	27	33	42	46	48	55
Potatoes	113	122	112	95	140	80
Hay	35	32	32	28	33	35

* * * * *

THE FUTURE OF BRITISH AGRICULTURE.*

The Right Hon. Lord ERNLE, P.C., M.V.O.

I HAVE never before addressed an audience of agricultural students. I find myself in this difficulty. I fear that what I am going to say may be to you as elementary as A B C. The unknown is always a bogey. I am ignorant, and, therefore, in awe, of the extent of your knowledge.

Your President has asked me to forecast "the Future of British Agriculture." Prophecy is easy. It is also dangerous. Fortunately for me, I am not a pessimist, and it is only the prophets of evil who catch the public eye. I can, of course, give you nothing but my personal opinions on a subject in which no certainty is attainable. The course of agriculture cannot be predicted with accuracy. It depends largely on fluctuating world-conditions. Even if it could be forecast in this country, the influence which the play of urban interests and party politics may exercise on its direction is incalculable.

I think that the future of British agriculture is bound up in arable farming—not for corn-production only, but for the combined production of bread, meat and milk. I think so for three main reasons. Firstly, it is tillage alone that can satisfy the demands of the community. Secondly, it is in the direction of tillage that science seems to be moving all along the line, and tillage can make the fullest use, over the widest range, of scientific developments. Thirdly, tillage, for the combined production of bread, meat and milk, unites in a common enterprise the two great branches of the industry, for the increase and improvement of our live stock become vital to the interests of arable farmers.

I shall not discuss the economic factors of the problem. They lie off the line of my inquiry, and they have been admirably treated in Mr. Orwin's Presidential Address before the Agricultural Section of the British Institution. But I realise that they strike at the root of the matter. How to combine the maximum of efficiency with the minimum of cost —how to attain the desired ends of increased production with the least possible expenditure of means—are matters of extreme urgency and importance. Economic difficulties hamper the maintenance and extension of arable farming. They block the

* An address to the Plough Club at Oxford.

way to the adoption of proved methods of increasing the output from the land. They affect the whole range of the farmer's business. I might insist, for instance, on the value of milk-records as the only test whether a cow is paying her way, or of co-operation in buying, selling and distribution. Or I might preach the advantages of establishing, on a commercial basis, those rural industries, by which, during the dead season on the land, agricultural workers might earn an adequate livelihood. Or I might urge the boon which would be conferred on agriculture, if a standard of economic efficiency in organization were formulated, and adapted to varying units of land or local conditions, so as to supply a test by which each individual farmer might check the economic efficiency of his own management. Or I might dwell on the need for supplying agricultural credit, and suggest the trial of one or other of the various continental methods. But, on this head, let me remind you that our system of landlord and tenant is, in effect, a practical means of supplying credit facilities. When a tenant takes a fully equipped farm, he virtually receives a substantial loan at the very moderate rate of interest which is represented by the rent.

Though I do not discuss the economic factors in the problem, I cannot get away from them. They crop up everywhere. They will not take " no " for an answer. They are specially important in regard to my first point. I shall steer as clear as possible of politics. But obviously, this reason for thinking that the future of British agriculture lies in tillage, namely, that tillage alone will satisfy the demands of the community, raises a number of social, political and economic questions.

The use to which agricultural land is put is no longer the private concern of owners and occupiers. It has become a matter in which the nation is vitally interested. This principle has, I believe, come not only to stay, but to exercise a growing influence. The needs of the community will have to be seriously considered. On the kind and quantity of the produce which is raised from the soil, and on the amount and remuneration of the labour that is employed, the nation will make its voice increasingly heard. Unfortunately, there is, at the present moment, for economic reasons, a sharp antagonism between the interests of the nation and of farmers. While the nation is intent on increased production, the farmer is cudgelling his brains how to make arable farming pay, and secure some return on his capital.

This economic antagonism cuts across agricultural operations at many points. A simple illustration is that of spring dressings of artificials on the wheat crops. Three of these dressings will considerably increase the yield of grain and of straw. It is, therefore, the national interest that all three should be applied. But the farmer has to consider the expense of the dressings in relation to the price of his produce. He has to decide whether they will cost more than the added yield is worth, whether he will give none, or stop after the first or the second. He acts accordingly. The nation asks for the maximum output; the farmer cannot produce more than he can afford.

But the most important example of this divergence of interests is afforded by the conversion of arable land to grass. When a farmer lays down his tillage to pasture, he relieves himself from many anxieties. He lessens his pecuniary risks. He makes himself more secure of a modest return on his capital. He has not to work so hard or continuously. He produces the two commodities—fresh meat and milk—which are least exposed to foreign competition. Above all, he reduces his *total* labour bill per 100 acres, a more important matter to him than individual rates of wages, by something between a half and two-thirds. As a man of business, he is prudent: as a farmer he is adapting himself to existing conditions. But the nation suffers a two-fold loss. It suffers, firstly, from the reduction of employment and its consequences—rural depopulation, urban congestion, increased competition for employment in towns, a lowered standard of national health and virility. It suffers, secondly, from the reduced output of food. Our grass-lands have been too much neglected: they can be and ought to be improved. Sir Daniel Hall is lyrical on lime; Professor Somerville puts his last shirt on basic slag. They are both right. Mine is a different point. Suppose you could eliminate from our poor pastures all the rush and bent and birds-foot trefoil. Suppose you could replace them with plenty of clover, rye-grass and dogstail. Suppose you could raise the quality of your Poverty Bottoms to that of those rare parcels of pasture which are justly classed as rich. Even then, you would be unable to raise half the quantity of food, measured in meat and milk, which could be produced from the same acreage of average arable land. In 1870, agriculture fed with home-grown food something like a third more people and employed a third more labour, than it did in 1913. Why is its

power to support or employ a portion of the population reduced? In the main, it is because we have had to turn from arable farming to grass farming. I do not believe that the paramount urban interests would tolerate, for any length of time, an agricultural system which, on any extended scale, sought salvation in the conversion of tillage to grass, and the consequent reduction in output of food and employment.

The farmer's answer is simple. He says that, as a matter of business, arable farming cannot be made to pay; cheapness of food is incompatible with large production. A serious question arises. Will the ill-informed opinion of the towns have patience to wait, while inquirers in every branch of science collaborate with practical farmers to make tillage a business proposition, that is to say, to make it show profits? I think it will. The mass of the community are aware that, whatever changes are introduced, the economic problem of making tillage pay remains to be solved. If they see that a real, practical, combined effort is being made in this direction, they will give the requisite time. But the effort must be made.

Economic science will deal with the reduction of expenses to the minimum consistent with efficiency. To other branches of scientific inquiry we look for those increased yields from the soil, without a proportionate increase in the cost of production, which will give a margin of profit. So I reach my second reason for my faith in arable farming, namely, that tillage is the direction in which science seems to be moving all along the line, and that tillage is the branch of the agricultural industry which can benefit to the fullest extent, and over the widest field, by scientific developments.

Even with our present scientific resources, the prospect is encouraging. Over the whole range of plant-production on the farm there exist the widest differences between the exceptional and the average yields. In potatoes, for instance, the decennial average yield is not much over 6 tons to the acre. I do not know the highest recorded yield. But in 1918, on freshly broken pasture-land, 18 tons were raised to the acre. Or take mangolds. The average yield per acre is 19¼ tons. On an acre of newly broken pasture in 1918, 47 tons were grown. Or take the three cereals, wheat, barley and oats. The average yield of wheat is 31 bushels to the acre; the highest recorded yield is 97 bushels. Of barley the average yield is 32 bushels, and the highest recorded yield is 80 bushels. Of oats the average yield is 40 bushels, and the highest recorded yield is

121 bushels. The decennial average, of course, represents good and bad farmers, good and bad land, good and bad seasons. Between the highest record and the average come the actual normal achievements of good farmers. They not only grumble, but are really disappointed, if they do not exceed 40 bushels of wheat or barley, and 50 to 60 bushels of oats. It is not impossible to raise the general average towards the actual achievements of good farmers, and, with the aid of science, to approximate to the record. If money is lost or balanced on the average yield, it would almost certainly be made on either of the higher yields.

To what causes are the differences between these three yields to be attributed? To the human agency, to favourable climatic and soil conditions, to the use of the best and most prolific varieties of seed, and to the adequate nutrition of the plant. We must not underrate the importance of the human agency. The personal equation counts for much. Good farmers are not in the majority. We want more men of energy, capacity, enterprise and education, men who will build up their practical experience on the foundation of a scientific training. We hope to get men of this stamp from Oxford and Cambridge. Capital is, of course, a necessity; the industry is often, for want of it, starved. Its provision is one of the economic problems.

There remain the natural limitations of climate and soil, the use of the best and most prolific seeds, and the adequate nutrition of plant life. It is here that science has helped, is helping, and will help still more.

Climatic conditions, especially rainfall, cannot be controlled by human agencies. It is this fact which mainly distinguishes agriculture from other industries. Farmers are at the mercy of the weather. They must adapt themselves to local conditions, humour their climate, grow the crops which it favours, avoid those which it resents. Speaking broadly, this is the only safe rule. On this principle the farming of this country is differentiated. The wet climate of the West favours leaf-production; the drier climate of the East favours grain production. But to some slight extent, climatic conditions can be modified. They can be modified by drainage, or to a less degree by the right use of artificial fertilisers. Thus phosphates help to mitigate the disadvantages of cold and wet, while, if the climate is too dry, potassic fertilisers promote the continued growth of the plants. To some extent, also, mechanical science helps farmers to steal a march on the weather. The preparation of a seed bed, com-

pact enough to keep the seed in contact with the soil, yet sufficiently broken to enable the infant roots to travel in pursuit of food, is obviously dependent on weather. So, also, is the right moment for sowing, on which hangs so much of the success of the crop. Few days in the winter months are favourable for either operation, and protracted harvests necessarily drive farmers into a corner. To be well forward with the autumn cultivations is an immense advantage. It gives the farmer the benefit of weathering his land by a partial fallow; it widens his choice of the best opportunity of getting in his seed. Time is of the essence and it is often lacking. It is here that mechanical science has already given valuable help. Tractors may not be cheaper than horse-ploughs. With the present prices of fuel and repairs they may be at least as costly. But they are as effectual, and far speedier in their working. They are also still in their infancy. Improvements in their mechanism may be confidently expected, as well as the application of their principle to other agricultural operations. Every step in these directions means greater control over the natural limitation of climate.

Another natural limitation is the character of the soil. Heavy land is favourable to leaf production, land of lighter texture to grain production. But soil conditions are much more amenable to human control than climatic conditions. Drainage, for instance, is a powerful controlling agent, by no means adequately employed. The natural limitations may, also, be profoundly modified by cultivation. In this direction great advances may be expected. The results of cultivation leap to the eye; but the precise nature of the effects produced are not yet scientifically ascertained. Cultivation is still rather an art than a science. Knowledge is control. Progress has already been made in the study of the physics of the soil. We stand on the threshold of great discoveries. We know that the soil is not a dead mass of mineral particles. It is teeming with life. In the multitudinous struggle for existence which goes on beneath the surface, each living organism influences the changes which affect the growth of plants. Science is making a determined effort to master this subterranean chemical laboratory and to direct its operations. If it succeeds—and it will—the effects may be far reaching.

Let me give you one simple illustration. Clover is already one of the most valuable of our crops. It is so not merely because of the fodder that it supplies to cattle. It is so, also, because of its peculiar power of enriching the soil with nitrogenous

matter. Possibly science may be able to stimulate still further the action of the nodules at the roots in which this fertilising power resides. But the potential value of the crop is as yet limited by two of its characteristics. It cannot be grown continuously on the same land, and it is liable to more or less frequent failures, though these may, of course, be mitigated by an admixture of grass. If the study of the biology of the soil solves the mystery of the failure and enables farmers to grow the crop continuously on the same land, the full potentialities of clover will be utilised to immense advantage.

Further control over the natural limitations of soil conditions, as well as the proper nourishment of plant life, are gained by the command and right use of farm-yard manure and of artificial fertilisers.

As the best of our all-round manures, " muck " is the basis of the manuring system of the farm. Something between 35 and 40 millions of tons of farm-yard manure are produced annually in this country. It is probably no exaggeration to say that at least half is wasted from improper making and storage. Its management is a first-class test of a first-class farmer. Whether science will some day invent a method of fixing which will prevent the leakage of the precious urine may be doubted. The clamp, properly placed and made, at present holds the field as the best preventive of waste. Again, the bacteriological process of rotting straw may be valuable where there is an excess of straw. Its cost works out, I believe, at something like 5s. per ton. But, for myself, before buying the plant I should be inclined to try a larger head of stock. Under the modern hygiene of the dairy, there is a danger that the manure of dairy cattle may be wasted. To avoid contamination of the milk, bedding can only be used sparingly and the stalls must be cleaned out at least once a day. It is a matter which has not escaped the attention of science, and a remedy will, I believe, be found.

Large as is the supply of farm-yard manure, it remains inadequate. In this respect agricultural chemistry has supplemented the resources of farmers. But artificial fertilisers are more than a supplement. Their best results are generally obtainable in combination with farm-yard manure. Few persons suppose that chemistry has shot its bolt, and that no new combinations or ingredients may be discovered. In the intelligent use of the substances already known much remains to be done. Many men still do themselves as much harm as

good by the choice of the wrong fertilisers. In the saving of the most valuable properties of farm-yard manure, in greater knowledge of the use of existing fertilising agencies, and in the future discoveries of agricultural chemistry lie great potentialities of increased yields without a proportionate increase in the cost of production. Not the least of the advantages of improved machinery and implements and of the greater command of fertilising agencies, is the freedom which they confer on farmers from the too rigid tyranny of rotations and the necessity of fallows. Weeds can be rapidly eradicated by the one, and fertility maintained by the other, with the result that the same crops can be grown continuously on the same land.

Increased control over climate by the use of improved machinery, increased control of soil conditions as the result of the study of the physics of the soil, increased control of the foods appropriate to plant nutrition are important steps in raising average yields towards the highest recorded yields. Another step is the increased command and use of the most prolific varieties of seeds. Plant-breeding is the fairy-land of agricultural science. No limit can be set to the possibilities in store, especially with the aid of a deeper knowledge of the physics of the soil. One example may illustrate the value of this collaboration. A very serious difficulty in introducing the most prolific varieties is the weakness of the stem. The strength of the straw is only in part dependent on the plant itself. Another part depends on soil conditions. Solve that mystery and the plant breeder will do the rest. Nor must the work of the plant pathologist be forgotten in the cure or prevention of plant diseases from a variety of causes. The annual loss from these pests is very large. I cannot vouch for the figure, but I have heard it estimated at 27 million pounds a year. It may bring home to us the magnitude of this sum, if we remember that it is, approximately, the net annual cash value to the farmer of his sales of the wheat and potato crops of the United Kingdom.

I have touched on a few of the ways in which science is helping to make arable farming a business proposition. I do not say that science has nothing to offer grass-farmers. It has much. But I have, I hope, shown that it is tillage which can profit most and over the widest range by scientific developments. You may, however, quite rightly remind me of the natural limitations imposed by climate and soil. You may ask, with reason, do not rainfall and heavy land restrict arable

farming to the dry climate and the soils of lighter texture. I do not think so. So I reach my third and last reason for my faith in tillage. Neither a moist climate nor a heavy soil restrict farmers to grass. There are arable crops which are equally adapted to these natural conditions, equally suited for the summer production of meat and milk, superior to pasture in supply of winter food, and yielding a much greater weight of fodder all the year round. Such are seeds, mangolds, vetches, peas, kale, rape and combinations of crops like oats and tares, or oats and peas, or rye and vetches. Some can be fed direct in winter; some can be turned into hay or ensilage for winter use; others can be fed green in the summer. Such a system lends itself to great extension and development. It reduces to a minimum the ration of roots, which, on the decennial average of a yield of under 14 tons to the acre, are absolutely ruinous to produce. It makes it possible to carry on three acres, two cows instead of one, maintain them in good health, and obtain an increased yield of milk. Keep your eyes open for the Reports of the Harper Adams College, and study the system wherever you find it even partially adopted.

Meanwhile, let me point out the features in which the system satisfies some of the requirements of which I have been speaking. It satisfies the demands of the community, for it produces per acre more food and employs more labour than grass. It profits by all the aid that science can render in the directions which we have traversed. It enables a heavier head of stock to be carried, whether for the dairy or the butcher, than can be carried on grass, and thus unites the corn-growing and live-stock industries in one common enterprise. It can utilise all that science may have to teach on the improvement of live stock for the various purposes for which they are bred, on their most economic yet efficient feeding, on their protection or cure from disease. It will give farmers command of more manure, and of richer manure, because it will be derived, not only from young growing animals, but from dairy cattle and, still more, from fatting beasts. It sets in motion the familiar round of the more fodder, the more stock; the more stock, the more manure; the more manure, the more fodder crops.

These are the main reasons why I think that the future of British agriculture is bound up, sooner or later, and, in my belief, sooner rather than later, in arable farming.

May I close on a different note? I accepted your President's invitation, because I take a semi-fatherly interest in the success

of your agricultural course and am convinced of its value to the country. Men of education, capacity and initiative are needed in the industry. For you there is a place and a lead, if you will qualify to take the one and give the other. Fortunes may be rarely made in farming. But I know few careers which are fuller of varied interests, few in which you can so long continue to learn, few which are richer in opportunities of service to your fellow men. I wish long life and prosperity to the Oxford Plough Club.

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FARM INSTITUTES.

PART I.

THE increased provision made by the Government for agricultural education since the War has enabled the Ministry to aid the establishment of several Farm Institutes. Farm Institutes are not intended to give the student a thorough training in agricultural science, or to teach him the way to farm. The aim is less ambitious. The time which a young man can spend at a Farm Institute is short—usually only the six " winter " months. During that period the Institute endeavours to give him instruction in the scientific principles underlying the practical experience which he gains on his own farm, and thus to send him back to the farm with a revivified interest in the work that lies before him. In one or two Institutes the course extends throughout the year, thus enabling instruction to be given in the field during the summer months; but normally the summer is devoted to instruction in dairying, etc., for women, when the Institute aims at giving the woman student such training as will render her an efficient partner in the management of a small farm. The farm attached to the Institute is not intended only for the benefit of the students, for their stay at the Institute is at a time when farm operations are reduced to a minimum. It certainly provides material for teaching, and the Farm Institute course is made as practical as possible; but beyond this the farm is the headquarters of the county staff of agricultural lecturers, serving to keep them up-to-date in farm practice. It is also a centre for experiments and demonstrations intended for the benefit of all farmers in the county.

From the brief *résumé* of courses, fees, etc., at the Farm Institutes which is given at pp. 477-80 of this *Journal*, it will be

seen that at the present time there are 12 Schools of this type in England and Wales. Two of them—the Chadacre Agricultural Institute, Suffolk, and the Monmouthshire Agricultural Institution at Usk—have been established through the generosity of private individuals. The others have been set up by County Councils with financial assistance from the Ministry. The main features of the training at four of the Institutions are given below.

EAST ANGLIAN INSTITUTE OF AGRICULTURE, CHELMSFORD.—The work of the Institute commenced in 1898, when the site of an old Grammar School in the centre of Chelmsford was purchased, and part of the old school buildings was fitted up and devoted to the teaching of biology and chemistry. Ten years later the present extensive and admirably equipped Institute, comprising lecture rooms, laboratories, dairy, library, museum, staff and common rooms, etc., was erected. In 1901 three acres of land, about three-quarters of a mile from the Institute, were acquired and converted into a school garden, which was laid out and equipped in such a way as to enable students to acquire a thoroughly practical knowledge of flower, fruit and vegetable gardening. Recently, an additional two acres have been acquired in order to provide facilities for instruction in market gardening.

Courses of Instruction.—*Agriculture.*—The course is designed for those who intend to take up farming or otherwise make their living on the land, and deals with soils, manures, farm crops, live stock, farm machinery, farm book-keeping and land surveying. The economical production of all forms of agricultural produce receives special attention. The session lasts from October to March. On an average 50 students, the majority of whom are farmers' sons, attend this course.

Two demonstration farms have recently been placed at the disposal of the County Agricultural Committee, viz., Bradfield Hall Farm and Layer Breton Hall Farm. The public-spirited action of the owners, Mr. J. Hepburn and Mr. William Hasler, in offering their farms for experimental and demonstration purposes without any charge to the county is warmly to be commended. On Bradfield Hall, a farm of 375 acres, experiments have already been carried out to ascertain the value of subsoiling and shallow sowing of cereals. Layer Breton Hall is a mixed farm of some 400 acres with a soil of

heavy London clay; approximately 270 acres are arable. The farm is equipped with a silo, and cow-shed for 52 cows. The intention is to determine the most suitable system of cropping for heavy land of this type.

Dairying.—Three courses of 12 to 16 weeks are given during the year. The dairy is fully equipped with modern apparatus and deals with upwards of 20,000 gallons of milk annually. The students, who are mainly the sons and daughters of farmers and smallholders, receive instruction in dairy farming, clean milk production, butter-making, soft and pressed cheese-making.

Horticulture.—The course of instruction is given in three terms, viz., an autumn term of 3 weeks, a spring term of 4 weeks, and a summer term of 4 weeks, and deals with the principles and practice of horticulture, being intended primarily for persons employed in garden work who propose to take up gardening as a profession. A teachers' gardening class, designed to qualify teachers for managing school gardens, is held on 12 Saturdays, from October till May, and during a fortnight in July.

External Lectures.—Single lectures or short courses of instruction are arranged at centres in the county. The subjects dealt with include agriculture, horticulture, cheese-making, fruit bottling, poultry management and beekeeping.

Advisory Work.—The Principal (Mr. R. M. Wilson) and members of the staff have many opportunities of co-operating with farmers, market gardeners, smallholders and others in the solution of farming problems which arise in connection with such matters as the cultivation of soils, farm machinery, rotations, manures and manuring of crops, food stuffs and feeding, milk production, dairying, breeding, rearing and management of live stock, management of orchards and apiaries, plant diseases and insect pests. Well over 1,000 inquiries on these subjects are dealt with annually. Several hundreds of samples of soils, manures, food stuffs, and dairy products sent in by farmers are analysed and reported on every year. The Institute deals with various farming problems through the "Essex Farmers' Journal," which is published monthly and is sent to 3,500 farmers.

Experimental work is carried out by the staff to demonstrate or investigate any matter of special importance to Essex farmers. Many farmers in the county help by providing facili-

ties or by carrying out experiments on lines suggested by the Institute staff.

County Organisations.—The Institute is fortunate in being closely associated with the following county organisations:—

(*a*) The Essex Farmers' Union; (*b*) The Essex Agricultural Society, with which the Institute co-operates in clean milk production and various matters connected with its annual show; (*c*) The Essex Milk Recording Society, with which it co-operates in carrying out a scheme, having for its object the increased production of milk of high quality; and (*d*) The Essex Federation of Women's Institutes, for whom it provides lectures in various subjects. The Institute is also closely identified with allotment and horticultural societies throughout the county.

CUMBERLAND AND WESTMORLAND FARM SCHOOL, NEWTON RIGG, PENRITH.—This Institute is administered jointly by the County Councils of Cumberland and Westmorland. It was established in 1896, and provides accommodation for twenty-four students. A separate house for the Principal (Mr. R. Lindsay Robb) has recently been erected.

The courses of study are specially designed to meet the needs of the sons and daughters of the farming community of the two counties, stock rearing, dairying, poultry-keeping, and horticulture being given prominence in the curriculum. Special students are admitted for practical training in farm management. While the courses are designed for those who intend to farm, provision is also made for students who desire a more advanced course by the award of scholarships (tenable at Durham University, the British Dairy Institute, Reading, or other approved institution) to students of sufficient merit, enabling them to take a degree in agriculture or an advanced diploma in dairying. Women students are received from April to September, and male students from October to March.

Courses of Instruction.—A twenty weeks' winter course (October to March) is given in general agriculture. Instruction is given in live stock, crops, soils, manures, implements, machinery, dairying, agricultural science, veterinary science (including farriery), elementary surveying, book-keeping, building construction, and poultry keeping.

Three courses, varying from four to twelve weeks each, are given in dairying and poultry keeping. The syllabus

of the longest course embraces the science and practice of cheese-making, butter-making, production and handling of milk, feeding of dairy stock, elementary chemistry and bacteriology, with poultry keeping and domestic science as subsidiary subjects. The short courses are devoted chiefly to practical work in the dairy, with a few lectures on the principles underlying the practical work. These short courses also include poultry keeping, elementary horticulture and domestic science, and are designed to give the best all-round training to the womenfolk of the farm in the shortest time.

Newton Rigg is not at the experimental stage but has long since won for itself an important place in the sphere of agricultural education. Over 1,120 students have passed through the school, over 90 per cent. of whom have been absorbed into practical agriculture.

Farm and Stock.—The farm serves as the central experimental farm for the two counties. It lies on red sandstone and comprises 167 acres of good medium loam, 80 acres being arable, and 87 pasture. Extensive trials are carried out with different varieties of cereals and roots, and experiments are also conducted in the manuring of crops, the laying down of pastures, the manuring of grass land and the feeding of stock. A herd of dual-purpose Shorthorns is maintained with the object of grading up a heavy milking herd of pedigree stock, and a small flying flock of ewes of different crosses is kept, these being mated with rams of different breeds to make possible a comparison of the merits of different crosses for the production of fat lambs. A small pedigree herd of Cumberland pigs has also been established, and a few Large Black pigs are kept with a view to comparing the merits of these breeds when fed on the outdoor system.

Poultry Keeping and Horticulture.—During the winter months lectures on horticultural subjects are given at local centres, and short courses are arranged. In addition to an excellent fruit plot and vegetable garden at Newton Rigg, there are eight demonstration plots at Lyth, Brampton and Abbeytown where various experiments are conducted from time to time. Many visits are paid each year to private and school gardens, and the advisory work done by the staff in this connection is considerable. The allotment plot, which is cropped in accordance with the Ministry's scheme, has been a great success, and during the summer and autumn supplies vegetables regularly to the school.

The poultry department has proved exceedingly popular and many applications have been received from pupils desirous of specialising in the poultry industry. Pupils taking the dairy course have received a good training in the hatching and rearing of chickens by natural and artificial methods, the management of laying stock and—most important in the public eye—the dressing of table poultry.

The increasing popularity of the Institute is shown by the fact that the demand for admission exceeds the accommodation available.

CHESHIRE SCHOOL OF AGRICULTURE, REASEHEATH, NANTWICH.—Reaseheath Hall and Estate was acquired by the Cheshire County Council in 1919. The Hall serves as a hostel for the staff and students, and the adjoining buildings have been converted into chemical and biological laboratories, lecture rooms, etc., on the most modern lines. The maximum number of students that can be accommodated is at present 41.

The Principal of the school is Mr. W. B. Mercer, and the staff includes lecturers in agriculture, farm chemistry and biology, horticulture, poultry keeping, dairying, and veterinary hygiene. A farrier and carpenter are also attached to the staff.

Courses of Instruction.—The main courses of instruction are in :—

Agriculture.—A winter course is held for about 22 weeks from October to March, and a supplementary summer course (on a higher level) begins in April and lasts for 12 weeks. Everything possible is done to make the courses interesting to students, who, in addition to attending the ordinary lectures, laboratory classes and farm demonstrations, are given facilities to attend local markets and to visit neighbouring farms and other places of particular agricultural interest. One day in each week is devoted to practice in manual farm operations. Students are also accepted for training in practical farm work only.

Horticulture.—The winter course, from October to March, is followed by a supplementary summer course from April to July. Limited numbers of students are accepted for training in practical gardening only. Sixteen acres of ornamental and kitchen garden land with several ranges of glass houses adjoin the hostel, and a fruit plot of three acres has been established. A considerable number of experiments on garden crops are conducted annually.

Poultry Keeping.—Two 12-weeks courses of instruction are arranged, beginning in January and April respectively. The

poultry section covers 5 acres, and is fully equipped on modern lines, many of the houses having been built from designs supplied by the Ministry. A good deal of attention is devoted to artificial hatching, and large numbers of day-old chicks are supplied to residents in the county area. The instruction given includes the chemistry of foodstuffs, biology and joinery, in addition to practical poultry work.

The Farms.—Four farms are in the occupation of the County Council, viz., Reaseheath Hall Farm, Reaseheath Arable Dairy Holding, Henhull Farm, and the Worleston Dairy Institute Farm.

Reaseheath Hall Farm is approximately 200 acres in extent, including 54 acres arable, the remainder being permanent meadow and pasture. It is managed as a mixed holding. There is a herd of 85 non-pedigree milking cows, and the majority of the calves bred on the farm are reared; feeding of bullocks on the grass and in yards is practised, and a flying flock of sheep is kept. Breeding, rearing and feeding of Cumberland and Large White pigs is carried on. Field experiments are conducted on a fairly extensive scale.

The *Arable Dairy Holding* of 35 acres, 25 of which are arable and 10 pasture, is equipped with a very fine set of modern buildings. A concrete silo capable of holding about 150 tons of silage has been erected and admirable arrangements exist for testing the possibilities of arable dairy farming on a small scale. About 20 head of milking cows are carried, with young stock in addition; and the number is likely to be increased.

Henhull Farm adjoins Reaseheath Farm and extends to 210 acres, 75 acres being arable. Though worked in the main as an ordinary dairy holding, it is used for purposes of demonstration and experiment, whilst part of the practical work included in the curriculum is carried out here. A herd of 70-80 non-pedigree milking cows is kept, the milk being made into cheese on the farm. Large scale trials on the feeding of cows, and on the various arable crops are conducted, and as definite results emerge from the experiment on the arable dairy holding they are retested on a larger scale at Henhull Farm. Large numbers of pigs are reared and fattened.

Worleston Dairy Institute Farm.—Cheshire has for many years conducted a successful dairy school for women at Worleston, the dairy institute having been established in 1886 and taken over by the County Council in 1891. Three 14-weeks courses are held annually; the instruction given is mainly in

FIG. 1.—Cheshire School of Agriculture, Reaseheath.

FIG. 2.—The Laboratory.

FIG. 3.—Cheshire School of Agriculture, Reaseheath. A Stock Judging Class.

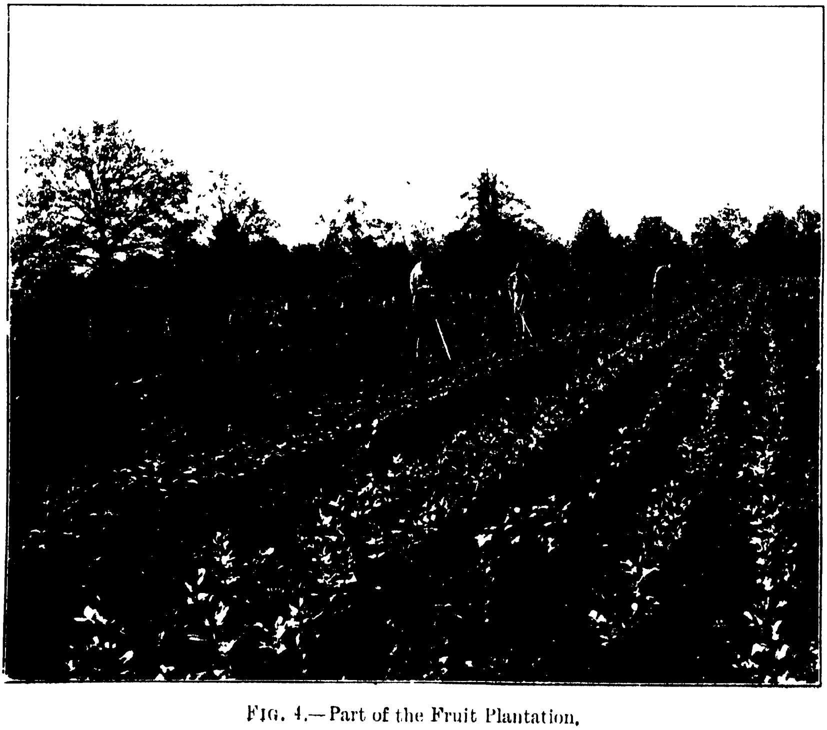

FIG. 4.—Part of the Fruit Plantation.

the making of Cheshire cheese. There is hostel accommodation for 20 students and about 40 pass through the school every year, many taking more than one course. The farm covers 180 acres of grazing land, the soil being heavy clay and not suited to arable cultivation; from 70 to 80 acres are mown annually. The farm is well equipped with buildings, and a herd of 60-70 good class commercial cows is kept. Large numbers of pigs are reared annually.

LLYSFASI FARM INSTITUTE, RUTHIN, DENBIGHSHIRE.—The Denbighshire Education Committee purchased for the purposes of their County Farm Institute, which was opened in May, 1920, a farm known as Llysfasi Manor Farm, situated 4 miles from Ruthin at the upper end of the Vale of Clwyd. The ancient farmhouse, now modernised and equipped with the latest conveniences, provides residential accommodation for 14 pupils, but more students can be admitted to the Institute, as sleeping quarters can be secured in the immediate vicinity.

Mr. Isaac Jones, formerly lecturer in agriculture at the University College of North Wales, is Principal of the Institute, and is assisted by a staff of five instructors and instructresses in various subjects, who, in addition to the school work, are engaged in conducting lectures and classes in agricultural subjects at centres in the county.

The Farm and Stock.—The farm is well supplied with timber and water and extends to 600 acres. About one-third of this acreage is very fertile soil lying in the vale, while 200 acres is more hilly land and poorer in quality, but fairly representative of the usual type of soil in the upland districts of Wales. The remaining 200 acres is rough sloping ground, rising gradually from 300 ft. to 1,000 ft. and suitable only for carrying ponies, matured store stock, and sheep.

The system of farming engaged in is of the mixed type, with a leaning towards dairying, a considerable quantity of milk being necessary to meet the requirements of the school dairy. About 30 dairy cows are maintained, together with 50 head of young stock, including both the Shorthorn and the Welsh Black breeds. Milk records are taken and the herds are being improved by selection. A flock of over 600 sheep is maintained, mainly of the Welsh Mountain type, but including small flocks of the Southdown and Improved Welsh sheep.

Experiments are conducted on the farm in connection with seed mixtures, manuring, feeding, etc., and the results obtained

are explained to the students. In this way the student is able to appreciate the value of different methods adopted for dealing with various problems.

Courses of Instruction.—Four courses, each of 10 weeks' duration, are arranged at the Institute during the year—two for men and two for women. An examination is held at the end of each course on the result of which certificates are awarded to those who reach the required standard. In the autumn course for men, instruction is given in agriculture, agricultural chemistry and botany, veterinary hygiene, land surveying, book-keeping, horticulture and dairying, and a more advanced continuation course is arranged in the winter for students who are able to remain at the Institute for the longer period, some of whom may desire to proceed to a University College.

A course in dairying, horticulture and poultry keeping is held in the spring for farmers' daughters and other women interested in rural industries, while a continuation course in the same subjects is conducted in the summer to meet the needs of women students who desire to secure posts as dairymaids or cheese-makers at factories, or who may wish to enter a University College in order to qualify for the National Diploma in Dairying.

The Education Committee offer a limited number of scholarships to residents in the county who wish to attend courses at the Institute, and, on completing their course at the Institute, students from the county may compete for scholarships tenable at Bangor College. It is therefore possible for a student to proceed from the Institute to the University and take a degree course.

It should be borne in mind, however, that the instruction provided at the Institute is designed primarily to enable the young men to make a living by farming. Too much emphasis cannot be laid on the practical side of the work conducted at the Institute. The various operations on the farm afford an opportunity for impressing upon students the importance of applying science to practice.

The belief so prevalent in the rural districts of Wales not long ago that education was a luxury in the case of the cultivator of the soil no longer exists, and the establishment of Institutions such as the one at Llysfasi shows that the agricultural community realises the advantage of a training at a Farm Institute for equipping a young man for life on a farm.

THE FATTENING OF CATTLE.

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A BULLETIN of more than ordinary interest on the above subject,* published by the Agricultural Experiment Station, University of Minnesota, U.S.A., in 1920, has recently come to hand.

The mass of new and interesting data presented is almost overwhelming, and only a very brief notice is here possible. The experiments described in the publication began in 1907. In all 189 head of cattle were employed. Of these 63 were slaughtered at various stages from 100 lb. to 1,500 lb. live weight. Complete analyses of the bodies of these animals were made, the data including details of the composition under such heads as Flesh, Edible Offal, Bone, Blood, etc. So far as this country is concerned, the only data of this sort published relate to *three* beasts only, slaughtered and analysed by Lawes and Gilbert at Rothamsted in 1849.

A unique feature of these experiments, however, is that all the food employed from beginning to end was weighed and analysed so that we have presented in this bulletin not only the composition of the steers at each stage (each 100 lb. increase of live weight) but also the analysis of all the food consumed up to each stage in terms of protein, fat, etc. In all 52 elaborate tables of figures are given, but, unfortunately, the letterpress with which they are accompanied hardly does justice to the unique value of the data which the investigation provides. The two accompanying figures have been constructed to illustrate roughly some of the more outstanding results.

Fig. I embodies some of the data obtained by analysing the bodies of steers slaughtered at stages of 100 lb. from 100 to 1,500 lb. live weight. It shows in a graphic manner that:—

1. After 600 lb. the fat laid on the edible portions of the carcass rapidly increases, whereas the protein (roughly dry matter of the lean meat) increases slowly and proportionately to the increase of live weight.

2. The rate of fat deposition begins to increase very rapidly after 900 lb. is reached.

3. Contrary to the usual opinion, the rate of fat deposition in the offal is slower than that of flesh fat, and in absolute amount is comparatively insignificant at all stages.

* Investigations in Beef Production—University of Minnesota. Bulletin 193—T. L. Haecker.

Fig. II has been prepared to illustrate a feature of beef production which came into prominence during the War—the "waste" of food involved—especially in the later stages. The upper curve shows the total quantity of food consumed (from calfhood) by a steer at each stage in the fattening process. For example, a steer of 1,000 lb. (9 cwt.) live weight was, on the average, 600 days (20 months) old and *up to that time* had consumed in all nearly 6,000 lb. of food, or 6 times its weight, expressed as dry matter: whereas a steer in reaching 1,400 lb. live weight, consumes 3,000 lb. more food, or 9,000 lb. in all, equivalent to nearly 6½ times its own weight.

Combining this graph with the first, it is obvious that this additional 3,000 lb. practically entirely goes to increasing the fat of the flesh.

It should be noted that in these experiments the animals were stall-fed from calfhood. They must have all been excellent "doers," for 1,400 lb. was reached on an average in 25 months. Nor was the feeding extravagant. At the 1,000 to 1,100 lb. stage the ration was only 17-18 lb. dry matter *per diem*, or in terms of actual materials, 9½ lb. grain, 7 lb. hay and 13½ lb. silage. At 1,200 lb. the steers were graded in the market from "choice" to "prime" fat and sold at good prices.

It may be of interest to note also that the "fat ox" of the Rothamsted experiments in 1849 was found on analysis (at 1,400 lb. live weight) to contain 30 per cent. of fat. At the same live weight these American animals contained on an average 28 per cent. of fat.

In regard to this matter of beef production, there still remains, however, one matter requiring investigation. We have no experimental evidence on one important point. We do not know what degree of fatness of the body (or of the flesh) as a whole is necessary in order to secure the ideal joint from the point of view of the butcher and the cook. The extraordinary wastefulness of securing the last 400-500 lb. of fat in the body as a whole is placed beyond all doubt by these experiments. But it may be that until the total fat is pushed to 30 per cent. the ideal joint with its appetising mixture of marbled fat is not produced. On the other hand, it may well be, as maintained by the Cambridge workers, that "baby" beef provides everything that the butcher and cook desire. But the matter cannot be settled in the absence of further experimental work, such as, it is understood, is now proceeding at Cambridge.

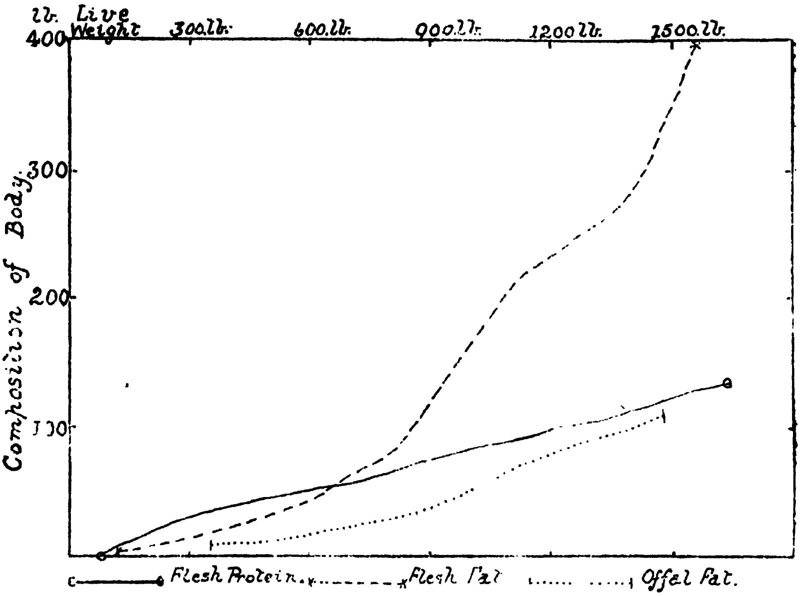

Fig. 1.—Composition of Body at different weights.

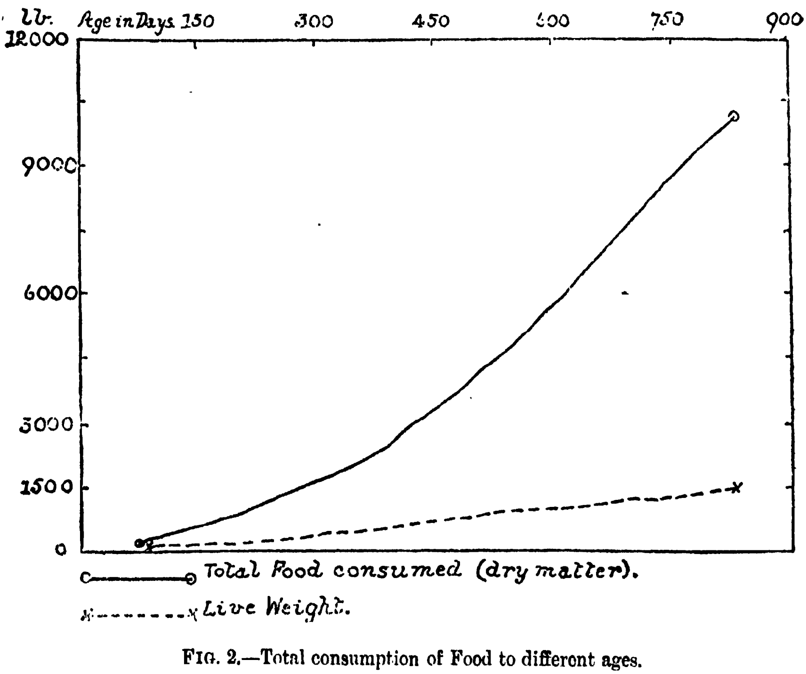

Fig. 2.—Total consumption of Food to different ages.

In the meantime, the Bulletin under notice will repay the careful study of investigators and agriculturists, containing, as it does, a mass of new and accurate data on a much debated problem.

* * * * * *

THE COST OF MANUAL LABOUR IN MILK PRODUCTION.

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and
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THE labour bills in the cost of milk production may be divided into (1) *direct* and (2) *indirect charges*.

The *direct* charges will include the cost of labour required for direct attention—milking, feeding, grooming, cleaning out the byres, bedding down the cows, scalding and cleaning the milk utensils and attention to the stock bull.

The *indirect* labour charges will include the cost of the labour utilised in the production of that part of the home-grown foods fed to the cows.

Since the year 1908, considerable time and attention have been devoted in the Department of Agriculture of the University of Leeds, to investigating the varying costs of milk production in a large number of herds in different parts of Yorkshire. As a result of these investigations it may be stated :—

a. That one man has on the average been fully employed	
during the winter months in direct attention to ...	12 cows.
during the summer months to	18 cows.
and during the whole year to	16 cows.

In other words, each cow has on the average required for direct attention the whole-time labour of one man for 23 days per year.

b. That each cow has had on the average the grazing of 1·5 acres of *grass*, and consumed, in addition,
18 cwt. of *purchased food*,
15 cwt. (or the produce of 0·6 acres) of *hay*,
15 cwt. („ „ „ 0·3 „) „ *straw*,
and 4 tons („ „ „ 0·2 „) „ *roots*.

During the twelve months 1919-20, when 22 Yorkshire herds were being costed, the total labour bill per cow direct and indirect amounted to £13 6s. 11d., and was made up as follows:—

	Horse s.	Horse d.	Man £	Man s.	Man d.	
a. Direct Labour in attention to each cow						£10 3 4
b. Indirect Labour						
i. Employed on 1·5 acres of grazing land	5	2	0	9	3	
ii. In production of 15 cwt. of hay ...	6	1	0	11	4	
iii. „ „ „ 15 „ of straw ...	3	3	0	15	0	
iv. „ „ „ 4 tons of roots ...	7	6	1	8	0	£3 3 7

	Horse	Man
Total Labour Bill per cow per year	£1 2 0	£13 6 11

TABLE I.—THE AVERAGE YEARLY MAINTENANCE COST OF A COW, 1919-20.

	Average yearly cost of upkeep per Cow, 1919–20. £	s.	d.	Cost per Gallon of Milk. £	s.	d.	Percentage cost.
Purchased Food Stuffs	20	0	6	0	0	8½	38·5
Man Labour Bill—*a.* Direct	10	3	4	0	0	4½	19·6
b. Indirect	3	3	7	0	0	1¼	6·1
Horse Labour	1	2	0	0	0	0½	2·1
Depreciation of Cows	8	0	0	0	0	3½	15·4
Tradesmen's Bills, including seed and manure of home-grown foods fed to cows	5	9	4	0	0	2¼	10·3
Rent and Rates of Land and Buildings	4	2	9	0	0	1½	8·0
	£52	1	6	£0	1	10	100·0

That the man labour bill is an important factor in the cost of milk production will be seen from the figures in Table I, which show that in the year 1919-20 it amounted to approximately 6d. per gallon, and represented nearly 26 per cent. of the total yearly cost of maintenance of each cow. With the present fall and the probability in the near future of a still larger fall in the price of milk, the milk producer will have carefully to study his labour bill if he is still to make the production of milk a remunerative transaction. As he will naturally be unwilling to bring down the actual weekly wages of his men lower than is absolutely necessary it will be to the better organisation of that labour and the adoption of more or less simple labour saving

devices that he will in a large number of cases have to look in order to effect the necessary economies.

During the year 1916-17, in the 14 herds then under observation 15 per cent. of the total cost of production of milk could on the average be charged to the total labour bill. At that time the average labour bill worked out at £2 10s. 0d. per cow during the summer months, and £3 3s. 0d. per cow during the winter months, or £5 13s. 0d. per cow per year; the weekly labour bill per cow averaged 1s. 11d. in the summer, 2s. 5d. in the winter, and 2s. 3d. all the year round, and the average labour bill per gallon of milk corresponded to 1¾d. during the summer months and 2½d. during the winter months.

In the individual herds during that year, the influence of the labour bill upon the cost of milk production varied very considerably, from £4 4s. 3d. per cow per year (or 1s. 7½d. per week) to £10 7s. 9d. per year (or 4s. per week), and from 1½d. to 4d. per gallon of milk produced.

At that time, as one would naturally expect, the wages of the men varied considerably on different farms, actually from 26s. to 40s. a week, being higher in the vicinity of the coal-mining areas and the manufacturing towns where the competition for labour is keener. Still, this variation in the wages bill per head was not so important a factor in influencing the cost of milk production, as the relative amount of labour employed in attendance on the cows, which, unlike wages, is not determined by the geographical position of the farm.

Thus in *Herd O* during the summer months of 1917 one man was employed quarter time, and a second man was employed one-fifth time in attending to 13 cows: an equivalent of one man fully employed for every 29 cows.

In *Herd L* in attending to 36 cows for the corresponding period two men and one boy were employed full time, and one man one-third time: an equivalent of one man fully employed for every 14 cows.

In a well managed herd, the labour employed should not be greater than an equivalent of one man fully employed for every 18-20 cows in the summer and one man fully employed for every 12-14 cows in the winter.

Actually, as will be seen from Table II, the number of cows attended to by one man varied on the different farms from 29 to 14 during the summer months and from 16 to 10 in the winter months.

TABLE II.—VARIATIONS IN AMOUNT AND COST OF MANUAL LABOUR IN MILK PRODUCTION.

Herd No.	Average No. of cows attended to by one man.		Cost of labour per gal. of milk produced.			
			1916–1917.		1919–1920.	
	Summer.	Winter.	Summer.	Winter.	Summer.	Winter.
O	29	16	1d.	1¾d.	2d.	4½d.
C	23	16	1¼	2	2½	3¾
W	21	14	1½	2½	3	4¾
T	20	14	1½	2¾	3½	5
K	17	13	1¾	3	3½	5½
N	17	12	1¾	3	3¾	6
OA	16	12	1¾	3	3¾	6
I	15	11	2	3	5	7½
L	14	10	2¼	3¼	5½	8¼
S	14	10	2½	3¼	6½	1/0¾
G	14	10	2¾	3½	10¼	1/0½
Average	18	12	2	3	4½	7

In 1916-17, when the average wages of a man on the farms "costed" were approximately 35s. a week, the wages bill per cow should rarely have exceeded 2s. per week in the summer or 3s. per week in the winter. In 1919-20 when wages were up to £3 and in many cases to £3 10s. 0d. per week, the yearly labour bill per cow, if that labour were properly organised, should rarely have exceeded £12 a year, or 4s. a week during the summer months and 6s. a week during the winter months; and where cows were giving a normal yield of from 500-550 gallons, the labour bill should not have added to the cost of milk production more than 4d. a gallon in the summer and 6d. a gallon in the winter, nor should the bill for *direct* labour have been responsible for more than 20 per cent. of the total cost of milk production.

In *Herd F* in the year ending 30th March, 1920, the labour bill per cow amounted to no less than £28 4s. 8d. per year, or 7s. 11d. per cow per week during the summer and 10s. 0d. per cow per week during the winter months; and in spite of the fact that the milk yield was particularly high, averaging 755 gallons per cow, the labour bill added 5½d. per gallon during the summer and 8¼d. per gallon during the winter months to the cost of production of milk.

In *Herd D* where the milk yield amounted only to 450 gallons per year, and the yearly labour bill per cow was £16 19s. 2d., this labour bill added a cost of 6½d. per gallon in the summer and 12¾d. per gallon in the winter.

In *Herd G* where a high yearly labour bill per cow of £16 14s. 5d. was accompanied by a low milk yield of only 360 gallons per cow, the labour bill added a cost of 10¼d. a gallon to the milk in the summer and 12½d. a gallon in the winter.

A milk producer may, as has already been stated, have to pay relatively high wages for attention to the cows, but where, as in the case of Herds S and G, that labour was not utilised to the best advantage, the management has apparently been at fault somewhere.

In the herds which have been under observation during the last nine or ten years, it has been interesting to note the various more or less successful attempts which have been made by the various owners to solve their special problems in trying to minimise the high labour costs in milk production.

On Farm B, a North Riding mixed farm of 318 acres (168 arable and 150 grass) on which between 50 and 60 milch cows are kept and milk is produced all the year round, the introduction of a Lister milking machine has proved very successful in reducing the *direct* labour costs of the herd.

Labour sheets kept on the farm show that in 1914, before the introduction of the milking machine, each cow kept the equivalent of one man fully employed in direct attention 26 days per year. During the year 1920-21, in spite of the shorter hours worked per day, each cow utilised in direct attention the equivalent not of 26 but 23 days' labour of a man. As the wage books show that during last year the wages of the cowmen on the farm averaged 9s. 6d. per day, and as the cows in the herd averaged 565 gallons per head per year, one might be justified in assuming that on that particular farm the introduction of a milking machine had resulted in reducing the wages bill in attention to each cow by about 28s. 6d. per year; and in reducing the cost of milk production by rather more than ½d. per gallon. Observations on other farms have led to the conclusion that unless the herd contains at least 40 cows, the reduction effected in the wages bill in attention to the cows has not justified the expense of the installation of the necessary plant.

On Farm F.W., a mixed farm in the North Riding of just over 300 acres (52 per cent. arable, 48 per cent. grass), on which milk production is the dominant feature, the economy of labour has been carefully and scientifically studied. The eldest son of the owner turned his engineering skill and ability to the easing of the

labour question on the farm. Attention was first paid to an old set of buildings which were at small expense adapted for use as a root house, cake house and straw chamber. Trolley lines were laid down in concrete made on the premises, along which the chopped roots, broken cake, meal mash and chop could be wheeled direct to the byre. The trolleys, substantially made, after the fashion of those used in the coal mines, were made on the premises under supervision. In 1916 a new byre with fittings and stalls for 40 cows was erected. It is fitted with a very efficient system of ventilation, the cows stand tail to tail. the trolley lines lead direct from the buildings beyond into each feeding passage of the byre, and the manure can be easily and readily got rid of by means of an overhead trolley system, leading to a small covered yard well away from the byre. From the byre there is a gentle slope down so that the full trolley is carried to the covered yard almost by its own weight, automatically empties itself and can, when required, be pushed back empty to the byre, with very little trouble. The trolley can be lowered by means of a chain lever for filling and again raised to any convenient height when sent to empty itself. Each cow has its own separate stall provided with simple and ingenious devices for preventing the cow from stealing her neighbour's cake, for automatically supplying herself with a constant supply of fresh drinking water, and for making it easy for her to be quickly and securely fastened, while yet leaving her sufficient freedom of movement.

A high standard of cleanliness is maintained; the milk produced is Grade A; and an extra 4d. a gallon over and above the varying local price is always paid for all milk coming from the herd.

A milking machine, the Amo, has been in use for five years and is found to work very satisfactorily, great care being taken to keep it scrupulously clean. Leading from the byre is a small room fitted with a weighing dial for recording the individual milk yields; after weighing the milk is poured into a hopper and passes directly into the receiver and cooler on the other side of the partition; the 17-gallon milk churns stand on a small weigh-bridge so that the total weight of milk sent out can be quickly and readily obtained. By these means also the milk is quickly removed from any possible source of contamination in the byre and under such conditions should leave the steading in a very " clean " condition.

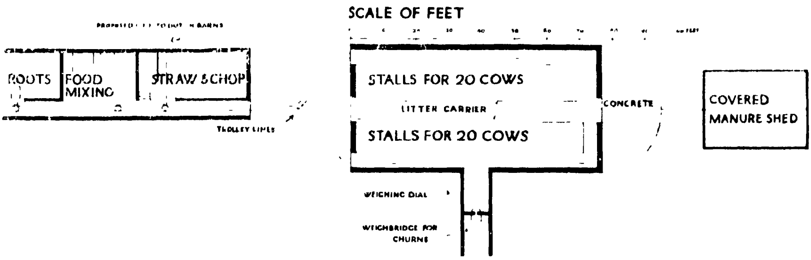

FIG. 1.—Ground Plan of Farm Building.

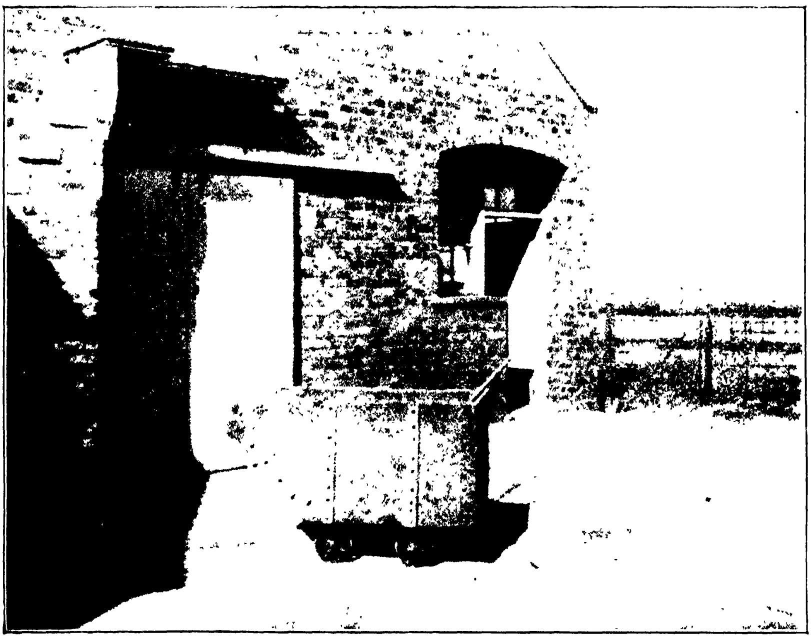

FIG. 2.—Showing Trolley-way to Feeding Passages of Cow-byre.

FIG. 3.—Interior of Cow-byre, showing Overhead Trolley system for removing manure.

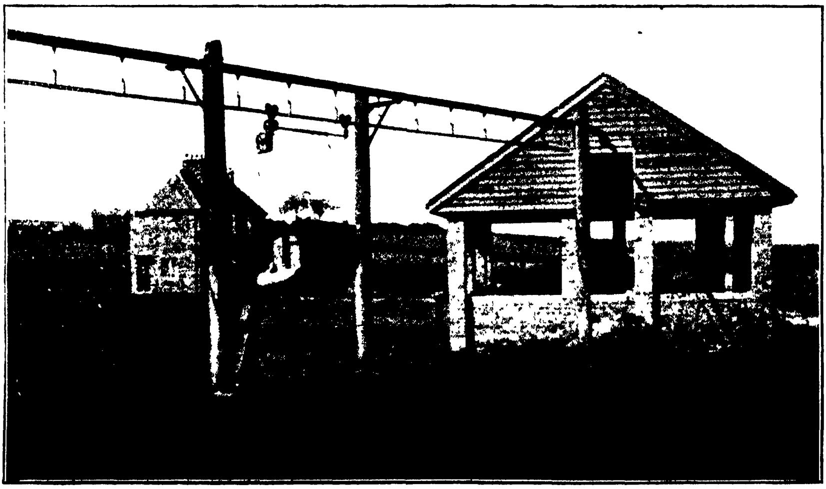

FIG. 4.—Covered Manure Shed with Overhead Trolley system from Cow-byre.

The men on the farm are well paid, and have every third Sunday off in addition to their half-day holiday a week; yet in spite of the precautions taken to get clean milk the labour bill per cow per week is comparatively low. In December, 1921, in attending to 105 total head of stock (40 milk cows, 2 bulls, 14 calving heifers, 14 feeding bullocks, 14 heifers 1-2 years, and 21 yearling heifers) there are employed:—

		£	s.	d.	
1 stockman	at	£3	5	0	per week.
1 man	"	2	12	0	" "
1 land girl	"	2	0	0	" "
1 woman, part time	"	0	10	0	" "
1 odd man on Sunday	"	0	6	0	" "
At a total cost of		£8	13	0	" "

of which, when £7 per week is charged to the cows, the labour bill in direct attention amounts to 3s. 6d. per cow per week, or 3d. per gallon of milk produced.

In many parts of Yorkshire, particularly the industrial area of the West Riding, and to a smaller extent some parts of the North Riding, milk producers have been heavily handicapped as far as their labour bill is concerned by the fact that the whole holding is subdivided into a series of small divisions each with its separate sets of buildings. Thus in the case of Farm P, a farm of 125 acres (90 per cent. grass) in the West Riding, the land was a few years ago rented under 10 different landlords, and the herd of 50 cows was housed in five distinct sets of buildings each two or three hundred yards apart. The lighting of these farm houses, with their three sets of windows on the ground and first floor respectively, suggests that each original small holder was partly engaged in the occupation of farming and part of his time taken up at the hand looms, many of which are at the present time still in existence in the neighbourhood. Up to quite recently the labour bill in the production of milk on Farm P has been particularly high, partly because of the high rate of wages which has to be paid in the vicinity of an industrial town and partly because of the uneconomic use made of that labour, when the cows were distributed over five sets of buildings. On this farm the labour bill in direct attention to 50 cows amounted in 1920 to £18 5s. 6d. per head per year, or 1s. 0d. per cow per week, and 8½d. per gallon of milk produced. On the adjacent holding, which was bought by the tenant some five or six years ago, wooden buildings have been erected out of material obtained from the disposal sales in which 40 cows can be stalled under

one roof. As a result of the economy of labour thus effected the labour bill per cow on this farm was last year about eighteen per cent. lower than that on Farm P.

On Farm H, a small farm of 92 acres (59 arable and 33 grass), in the North Riding, which was taken over by the present tenant three years ago as practically a derelict farm, a good deal of thought and ingenuity has been made use of in adapting to modern requirements, at very little cost, old and dilapidated buildings. A small six horse-power Powell paraffin engine with magneto ignition, root cleaner and pulper, cake crusher mill and chaff cutter, together with the necessary gearings, were picked up cheaply second hand and fixed by the tenant himself at a total cost of under £130. On this farm, on which before 1918 the arrangements for the feeding of stock were exceedingly primitive, no single labour-saving device existing, in 1919 in attention to 13 cows the labour bill amounted only to £6 1s. 1d. per head, 2s. 4d. per head per week, or 2½d. per gallon of milk produced.

Farm CA.—Perhaps one of the greatest improvements as far as the economising of labour in attention to stock is concerned has been made on Farm CA. When first we got in touch with the farm some three years ago the implements and machinery certainly needed bringing up to date. The engine used for grinding was a beam engine dated 1808, with a fly wheel 12 feet in diameter. The boiler—fitted with no tubes—was 21 feet in length. The extravagance of the fuel-consumption can be gauged from the fact that it was always necessary to start getting up steam the day before it was intended to use the engine for grinding. The grinding was done between millstones; there was no chaff cutter or root pulper or slicer on the premises, straw being fed long and roots fed whole; cake, however, was broken in a machine which had been devised and used for crushing bones in the days before bone meal and steamed bone flour were on the market.

In May, 1921, the old engine and plant were scrapped and sold for £56 10s., the fly wheel of the engine having to be broken up with dynamite charges before it could be removed! A gas engine, root cleaner and pulper, chaffing machine, mill and cake crusher, with the necessary gearings, were purchased for £192 5s. 0d., and fixed by means of the labour on the farm at a total net cost of £307 6s. 2d. for engine, machinery, material and labour after allowing for the £56 10s. 0d. received on the sale of the old plant.

While the improved system has not been long in operation, and it is perhaps early days to talk definitely of the economic advantages which have accrued, it may be stated that for the quarter ending 30th September, 1921, the gas consumed in running the engine amounted only to 1,100 cubic feet at a cost of 8s. 7d., and that while the labour bill in attending to the cows amounted in January, 1921, to 6s. 5d. per cow per week, or rather more than 6½d. per gallon, these costs at the present time are certainly twenty-five per cent. lower.

* * * * * *

THE PLANNING AND CONSTRUCTION OF COW-SHEDS.

II.

COVERED YARD AND MILKING SHED AT THE NATIONAL INSTITUTE FOR RESEARCH IN DAIRYING, READING.

Major H. P. G. MAULE, D.S.O., M.C., F.R.I.B.A.,
Ministry of Agriculture and Fisheries.

THE July number of this *Journal* contained an article on the construction of modern cow-sheds, and though the sheds illustrated contained some novel features, they followed the traditional method of keeping and milking cows in one building. Through the courtesy of the Board of the National Institute for Research in Dairying, and of Mr. Hutt, of Messrs. Charles Smith & Son, Architects to the Institute, it is possible in this number to describe and illustrate the plans of the new farm buildings which the Directors of the Institute are about to erect at Shinfield, near Reading. The most interesting point in these plans is that the method about to be adopted by the Institute embodies another principle in cowkeeping. The traditional cow-shed method is discarded in favour of the principle of keeping and feeding the herd in covered yards, milking being performed in a building erected solely for that purpose.

From the practical and structural point of view, this departure from tradition is of great interest and importance, coming, as it does, at a time when the necessity for improved methods in the production of clean milk is being increasingly realised, and many farmers are anxious to know what steps they can take to secure better conditions without undue capital expenditure.

Two points must, however, be borne in mind in connection with this scheme: (1) the fact that the method adopted is distinct in principle from the ordinary practice, and (2) that the peculiar needs of a Research Institute, where experiment and trial are the root factors, do not necessarily apply to ordinary commercial farming. Nevertheless, the plans offer some food for thought, and to those who own extensive but out-of-date and inadequate buildings, the suggestion may be of value that improvement for commercial purposes could be inexpensively undertaken on similar lines to those deliberately adopted by the Institute authorities.

There must be many farms where existing cow-sheds, no longer in conformity with modern ideas and methods of clean milk production, could be cheaply converted into milking sheds, and where, by the adaptation of an open yard into a covered yard somewhat on the lines of the plans shown, ample provision could be made for the accommodation of a considerable herd of milking cows, and at less cost than building a modern cow-shed for the same number.

Description of Plans.—Fig. 1 shows the general lay-out of the existing and proposed new buildings. It may be said that the old farm buildings are typical of thousands throughout the country, and though, at the present time, it is found possible to produce Grade A milk, it is doubtful if, under the physical conditions obtaining, it would be a commercial possibility, winter and summer, day in and day out, were it not for the never-failing vigilance and care of the Institute staff.

The fact that it is possible to produce Grade A milk under the existing conditions is a clear indication that it is the human element which is the most important factor, and that it is not elaborate or costly buildings alone which produce the desired results.

Reference to the site plan shows the relationship of the various new buildings, hatched in on the plan, from which it will be seen that these comprise a large farm steading, a milking shed, lavatories and cloak rooms, and a dairy. The new animal house and the other Institute buildings do not come within the range of the present article, which is intended rather to emphasise the principle adopted and call attention to the fact that such principles might be applied to existing buildings with comparatively little expense.

Fig. 3 shows the plan and general distribution of the main farm buildings, which in effect follow the traditional arrange-

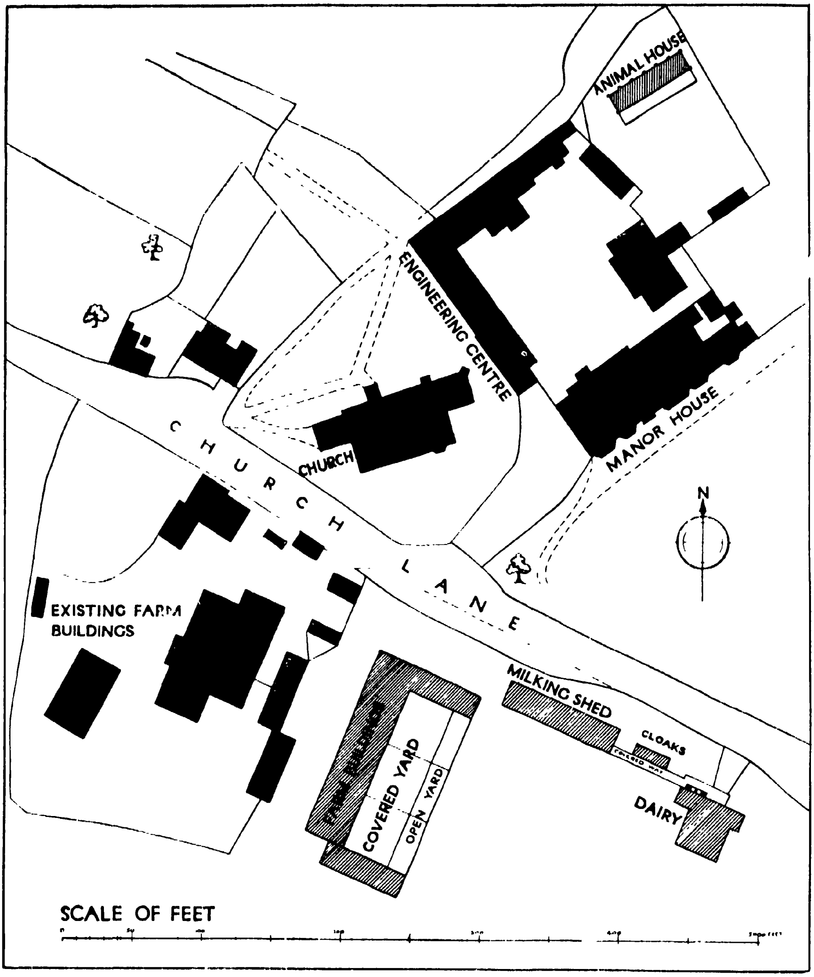

FIG. 1.—The National Institute for Research in Dairying, University College, Reading Block Plan.

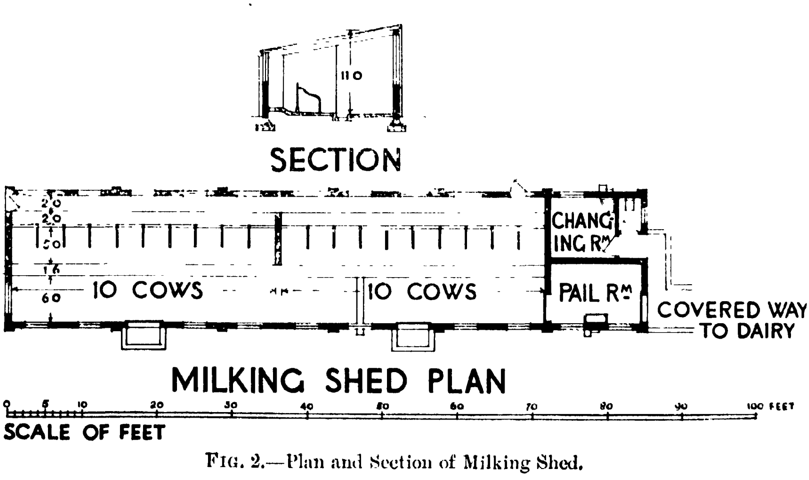

FIG. 2.—Plan and Section of Milking Shed.

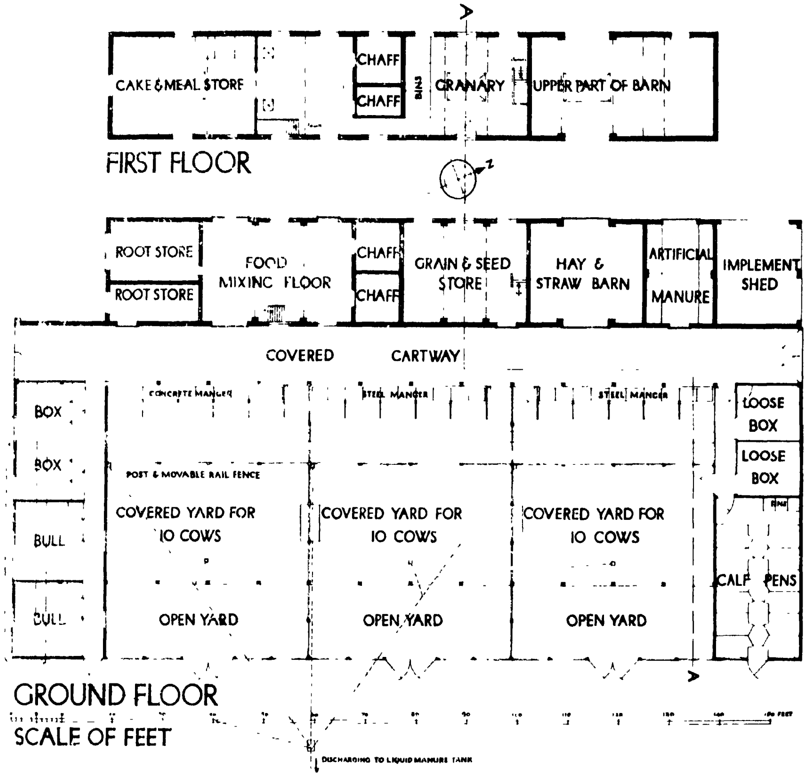

Fig. 3. Plan of Main Farm Buildings.

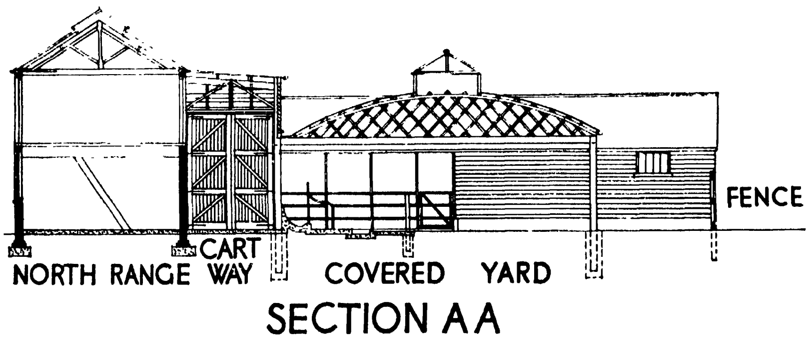

Fig. 4.—Section through line A A on Fig. 3.

ment, being grouped round the three sides of a square with the big covered yard in the centre.

To the north-west is placed the barn range, a brick-built and slated building, arranged for the concentration, preparation, and easy distribution of fodder of all kinds. The planning and arrangement of this building are practically normal, and call for no particular comment save that the upper floor will be constructed of fire-resisting materials with a grano paving finish. One of the distinguishing features of the plan is the covered cartway connecting the main range with the covered yard and stock sheds. The roof of this cartway, the stock boxes, and covered yard will be constructed in creosoted timber framing with felted roofs, as it is considered that these buildings thus constructed are more readily adaptable to meet changing conditions or the special needs of experimental work, as well as being less costly to erect.

The covered yard is, for the special purposes of experimental feeding and recording, divided into 3 equal portions each designed to accommodate 10 cows.

Mangers and standings for the 30 cows are placed immediately abutting upon the covered cartway and in close proximity to the administrative range, thus allowing for the most labour-saving means of attendance upon the animals. A post and movable rail fence separates the standings from the remainder of the covered yard.

The covered yard is roofed by means of Belfast truss principals at 12-foot centres with a clear span of 35 feet. The containing fence on the south side is placed 14 feet beyond the span of the roof, thus allowing some open yard area where stock can obtain full advantage from the sun. The floor of the yards will be of 6-in. rammed chalk.

The boxes on the south side have been designed with the intention of ultimate conversion to double cowstandings by the addition of another bay to the main Belfast truss roof, which is extended on this side to include the range of boxes. On the opposite side, to the north, a low span-roof building contains 2 boxes and a number of calf pens.

Drainage from the standings and covered yard is collected in a manure tank.

Thus it will be seen that the general arrangement of the buildings themselves is quite on traditional lines, save that it is perhaps more usual to find a central range separating covered or open yards. In such a case, were conversion

required, it might be possible to sacrifice the central range entirely, and convert the whole space between the flank ranges into a covered yard. The provision of a cartway on the south side of the barn range might be achieved in many cases by continuing the slope of the main north range roof where the range is a lofty building, as is so often the case.

It is only possible to suggest the main lines of such a conversion, but to anyone familiar with farm buildings the possibilities of following the general principles exemplified in these plans will be obvious.

The Milking Shed.—The site plan shows the milking shed, shown in Fig. 2, placed to the east of the main buildings. This shed has accommodation for 20 cows, and will be built in brick with grano floor, cemented walls and reinforced concrete slabbed roof, so that the whole building may be hosed down.

As cows will only be there for the short period of milking, the cubical content is of little importance and hence the shed has been designed on the most economical lines, so far as size is concerned. A narrow feeding passage 2 ft. wide is provided to facilitate the rapid placing of the cake or other foodstuffs consumed by the cows during milking. At the end nearest the dairy, provision has been made for a changing room with lavatory basin and a W.C. with external access from the covered way connecting the dairy and milking shed. A small pail room with a sink entered direct from the covered way and milking shed is also provided. The milk will be taken from the milking shed to the platform and poured into a receiver outside the cooling room of the dairy.

For general convenience the plan is hard to improve, and it is hoped that its publication will be of interest, not only to those who are considering the possibility of making alterations to their own buildings, but also to all who are interested in the progress of scientific farming, and particularly in the work which the National Institute for Research in Dairying is doing.

A future article will deal with the great advance in the production of clean milk which is being made in the Reading district under the guidance of the Institute.

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THE BRITISH FRIESIAN.

GEORGE HOBSON.

MANY of our native breeds of cattle were influenced by importations of Dutch stock, particularly during the 17th and 18th centuries, and large numbers of black-and-white Dutch cows were imported in the 19th century, especially in the 'seventies and the 'eighties. They were distributed chiefly over the counties on the east coasts of England and Scotland, although the best herds were probably preserved in other districts. With the passing of the Act prohibiting the importation of live cattle except for purposes of immediate slaughter, further landing was stopped. The breed, however, was not allowed to become extinct, and in 1909 a society was formed with the object of developing it and fostering its interests. The society was permitted in 1914 to obtain an infusion from Holland of much needed new blood; and the subsequent rapid progress of the breed is remarkable in the history of pedigree live stock. In 1911 the membership of the society was not more than 50. In 1922 the membership of the British Friesian Cattle Society is 1,950 or nearly forty times greater than ten years previously.

British Friesian cattle are similar to, if not so wonderfully uniform in breed character as, the world-famed Friesians of the Netherlands, and to the equally noted Holstein-Friesians of America, where this race holds all world's records for milk and butter production.

Improvers of the Breed.—Although much of the wonderful improvement in the conformation, symmetry and breed character of British Friesians is directly due to the influence of the animals imported from Holland in 1914, the work of the few breeders who practically prevented the extinction of this valuable variety of stock was of incalculable benefit, and the animals bred by, and descended from the strains owned by, these early pioneers have supplied the large majority of the numerous 2,000 gallon cows of the breed. Mr. John Twentyman, of Hawkrigg in Cumberland, developed a good herd in the latter years of last century, and from Hawkrigg went the cows that founded the well-known Colton herd of Mr. Hugh Brown. Two of the Hawkrigg bulls, Royal Duke and his son Hedges Hawkrigg Duke, proved two of the strongest pillars of the first Herd Books and two of the best and most impressive bulls in the breed. After twenty years the influence of Royal Duke in leaving big animals

and exceptional milkers can be traced in his descendants. Another early herd that proved of great assistance to pioneers was that of Earl Egerton of Tatton, who bred Hedges Tatton King, a bull used by Mr. Hugh Brown, of Colton, and by his brother, Mr. John Brown, of Hertford (later of St. Albans). After the Hawkrigg and Tatton herds had been dispersed, the breed was preserved by these two brothers, who developed the Colton and Hedges herds, the latter still in existence, to make history for the black-and-white cattle.

General Appearance.—British Friesian cattle are large in frame; they are of true milking type; and they possess the characteristics of dual-purpose cattle, rapidly putting on flesh when dry. The predominant colours are black and white, in about equal proportions. The colours must be very sharply defined, with very distinct patches. The head is long, and should be fine, with width between the eyes and at the muzzle. The horns are fine, curving inwards and keeping level with the poll; the neck is clean cut, fairly slender, but not too long; the chest is deep, with great thickness through the heart; the withers fine; the coupling long, and the belly low and exceptionally capacious, width and strength at the loins and a great spring of rib are essentials to allow for a tremendous barrel; the hind-quarters are broad, long and level, with greater width at the tail-head and through the thurls than in any other breed; the buttock is wide and flat; and the legs straight and strong.

Characteristics of the Breed.—*Milk Production.*—The outstanding recommendation of the breed is the extent to which the milk-producing properties have been and can be developed. Having been carefully and specially bred in Holland for centuries, the breed has the constitution to stand the strain of phenomenal production, the capacity to transmute large quantities of rough food into valuable merchandise and the ability to reproduce heavy yielders. The reports of the official milk-recording societies operating throughout the year under the control of the Ministry of Agriculture furnish ample proof of the value of the breed for milk yield. For two years in succession the Government's Annual Register of Dairy Cows has shown the eight heaviest yielders to be of the British Friesian breed, and in the matter of herd averages the breed has also led the way. Some idea of the progress made by this breed may be gathered from the fact that the first British cow to yield 2,000 gallons of milk in one year appeared early

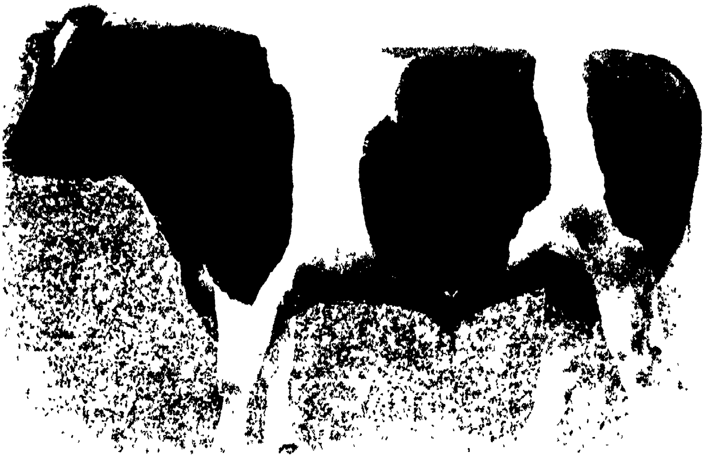

FIG. 2. Imported Friesian Cow.

in the year 1918, and the second late in 1919. At the time of writing the number of British cows with 2,000 gallon yields is 52, of which number all but 4 are British Friesians. The highest yield to date given by any pedigree cow is that of Kirkhill Flo 3rd, this cow having produced 2,602 gallons in 365 days, her butter fat percentage averaging 4.3 Such progress raises the hope that before long the production records of America and Canada, where at least 25 cows have yields better than 3,000 gallons in the year, may be reached. The best British Friesian production figures are the following:—

Kirkhill Flo 3rd	2,602	gal.	in 365	days.
Colton Secret 3rd	2,524	,,	,, 365	,,
Osmaston Jenny	2,427	,,	,, 365	,,
Lothian Gladys	2,417	,,	,, 365	,,
Eske Hetty	2,413	,,	,, 365	,,
Brookside Colantha	2,368	,,	,, 365	,,
Wiggington Geraldine	2,311	,,	,, 365	,,
Kingswood Myrtle	2,283	,,	,, 365	,,
Stanfield Dorrit	2,268	,,	,, 365	,,
Southill Countess	2,245	,,	,, 365	,,
Hedges (imported) Fronkje 3rd..	2,226	,,	,, 341	,,
Duchess Wildrose	2,219	,,	,, 365	,,
Beccles Cynthia	2,216	,,	,, 365	,,
Westwood Alexandra	2,207	,,	,, 365	,,

At one time the opinion was held that any cow could only give such a phenomenal yield of milk on one occasion, and then only if she was kept free from the bull for many months, but experience is showing that both these ideas must be modified, as several cows have given 2,000 gallons twice in successive years, and others promise to do so and to calve again within the year.

Butter Production.—Attention must be called to the fact that five cows of the breed are calculated to have produced the equivalent of over 1,000 lb. of butter in one year. The following is a list of the breed's best butter producers:—

	lb.		lb.
Kirkhill Flo 3rd	1,316	Hedges (imported) Froukje 3rd	942
Stanfield Dorrit	1,227	Kingswood Myrtle	940
Fillongley Abbotts Queen ...	1,093	Eske Hetty	936
Beccles Cynthia	1,059	Hedges Moss Rose	931
Colton Secret 3rd	1,001	Blackmore Snowdrop 3rd ...	931

From the above it will be gathered how great are the possibilities of the breed for butter production, as the smaller daily percentage figure is more than counterbalanced by the

greater production of butter-fat consequent upon the greater yield.

Dual Purpose Value.—These cattle are large framed, and their ability to put on flesh, especially when dry, is a special recommendation, as more milk and no less beef in a herd find favour with the majority of farmers. Steers of the breed grow to a great weight and make first quality beef, and it may be mentioned that a pure bred steer was the Champion Farmers' Beast exhibited at the Norwich Fat Stock Show in 1921, and that a steer sent to the Smithfield Club Show, 1921, was the heaviest beast of its age on exhibition.

Herd Book.—Ten volumes of the Herd Book have now been published, the last containing entries of no less than 1,408 bulls and 3,599 heifers, all of which were born and registered for entry in 1920. A recent census taken by the breed society showed that the number of registered animals in the possession of Members of the Society in the United Kingdom approximated 20,000.

Prices Realised.—In the year 1921, 2,308 lots were sold at public auction for an average price of £124 2s. 9d., while in the previous year 2,088 lots realised an average price of £167 10s. 0d. The highest prices were obtained in 1919, when 1,893 lots were sold for an average price of £174 5s. 5d. In 1911, the highest price given for an animal at public auction was £53 11s. 0d., and in 1915, 340 lots were sold for an average of £39 5s. 2d. The present strength of the breed is indicated by these figures, although of course the value of all classes of stock has risen considerably since 1915.

Owing to the long interval between the closing of the ports to live Dutch cattle and the formation of a Society to establish a Herd Book, the characteristics of the breed were impaired to such an extent that fresh blood became necessary. This was obtained from Holland in 1914, the animals imported being highly successful in improving breed type, symmetry and quality—in fact, in making the modern British Friesian breed. Another consignment, this time from South Africa, was obtained in 1922, when the 83 imported lots sold at auction for an average price of £1,242 15s. 10d. These two importations would seem to be completely justified, in the first case by the successful results obtained in herds, and in the latter by the very high prices paid for the South African Frieslands.

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THE GRADING AND SIZING OF APPLES.

J. TURNBULL,
Ministry of Agriculture and Fisheries.

WHATEVER opinion may be held as to the best package for marketing apples, it is generally agreed that better grading and packing are necessary. Good methods of packing have frequently been described, but little has been said about grading methods. Some confusion is caused because the word grading is used indiscriminately to mean sorting for quality or sorting for size. It would greatly simplify discussion if the latter were described as sizing and the use of the word grading were limited to grading for quality.

Grading (for Quality) must be done by eye, as, at present at any rate, no machine can tell the difference between green and red apples, or between clean and blemished fruit. There are two occasions on which it is convenient to grade—the first at the time of picking and the second at the time of packing—and advantage should be taken of both.

It is always good practice for a certain amount of grading to be done at the time of picking. Objection is taken to this on the ground that pickers are incapable of distinguishing between clean and blemished fruit. Such pickers should never be employed, as they will ruin the fruit in any case. It may not show for a few days perhaps, but the damage will be there. The pickers should collect only sound fruit reasonably free from blemishes. All seriously blemished fruit, jam apples, scrumps, and mummies should therefore be dropped on the ground near the foot of the tree. Care should be taken to see that the mummies are buried or burned. The others should be picked up and used or marketed as soon as possible.

When the crop is reasonably clean and is being marketed direct from the tree in wickers or half-barrels, it is usually graded and sized by hand by the packer, who places the fruit directly into the proper packages. When the bulk of the fruit is of one grade and size, the packer can run it through his hands into the baskets, picking out the other grades and sizes as he does so. When, however, there is a large bulk of two or more grades or sizes, it is better to run the fruit carefully on to a sorting table and pack from that. (A sorting table is simply a small table with a top of stout canvas instead of wood.)

When the fruit cannot be packed direct from the pickers' baskets, because it is being marketed in boxes, or has to go into store, or for any other reason, there are several appliances which may prove useful. Circumstances have forced the Western American growers to be pioneers in this respect, and it may prove of value to consider their practices. The remark is sometimes heard that just when the British grower is endeavouring to improve his standard, the American grower is slacking off—as evidenced by the shipments of the past season. That is, however, an entirely erroneous idea, which has arisen because the American used to send us his best grades, but now keeps them at home and sends us the inferior grades.

Estimates as to the extent to which different methods are in use appear in a recent publication of the U.S. Department of Agriculture.* These deal chiefly with central packing houses, that is packing houses which are operated either by the growers co-operatively or by individuals for profit. In passing, it may be observed that in 1916 it was estimated that a quarter of the crop was dealt with in such houses. In 1919 the proportion had risen to a half, and it is now probably still greater. This remarkable development gives considerable food for thought to the home grower, although it must be borne in mind that the circumstances in this country are not quite the same.

Methods of Grading and Sizing.—There are in common use three methods by which the fruit is graded and sized :—

(1) Entirely by hand.

(2) Mechanical aids to hand grading.

(3) Sizing machines.

(1) The first requires little capital outlay, and is favoured by the small grower, but experienced and careful packers are essential. The equipment consists of a canvas-topped packing table 26 in. wide and 30 in. high with division boards every 30 in. to separate the different grades. On one side is the sorting table, 20 in. by 30 in., and the packer's stand at the other side.

The fruit is poured carefully on to the sorting table, and the different grades (by quality, all sizes together), are picked out by hand and placed in their proper divisions on the packing table. The packer standing at the other side of the table sizes the fruit as he is packing it. If the crop is fairly clean one sorter can keep up with one packer, but if it is not, more sorters will be required than packers. When this method is adopted for packing into boxes, the packer will require a rest designed to hold three or four boxes, so as to clear up most of the sizes.

* Farmers' Bulletin—1204. North-western Apple Packing Houses.

This is a very good method, but obviously the sorters and packers require considerable skill and experience.

(2) The chief mechanical aid in use in the Western States is the grading belt. This is simply a wide endless belt, which by means of revolving drums is kept moving over a table, with sides to prevent the fruit from rolling off. At intervals along the sides are narrow channels. one for each grade, leading to trays or bins for receiving the fruit. The ungraded fruit is poured on to a slightly sloping table at the end of the belt and passes on to it. The sorters stand by the side of the belt and grade the fruit (for quality only) as it is carried before them by deflecting the apples into the proper channels. The sizing and packing is done from the trays in the same manner as from the packing table described above. The use of this belt represents a considerable saving in time, but it is still necessary to have fairly skilled packers to do the sizing correctly.

(3) If sizing machines did what they ought to do, they would always be used, because unskilled workers can easily learn to pack accurately sized fruit. They usually suffer from serious defects, however, the chief of which are that they damage the apples and do not size the fruit accurately. Even in the North-Western States where grading and packing is almost an exact science, and these particular defects have been overcome, the perfect machine has not yet been placed on the market. The chief difficulty appears to be in apportioning the work between sorters and packers so that all are kept fully employed. In spite of these difficulties it is estimated that about half the crop is sized by machinery, and it is admitted that the result is more uniform and reliable. It is therefore evident that they are working on sound lines and a brief description of the machines they use may be of interest.

Sizing Machines.—There are only two patterns in general use and they both size by weight, the idea of sizing by diameter having been abandoned. It must be remembered that they have to deal with three grades (for quality) and 8 or more sizes of each grade. The smallest machine of the pattern in commonest use makes 8 sizes of one grade only and is 30 ft. long; the largest makes 48 sizes and grades and is 52 ft. long.

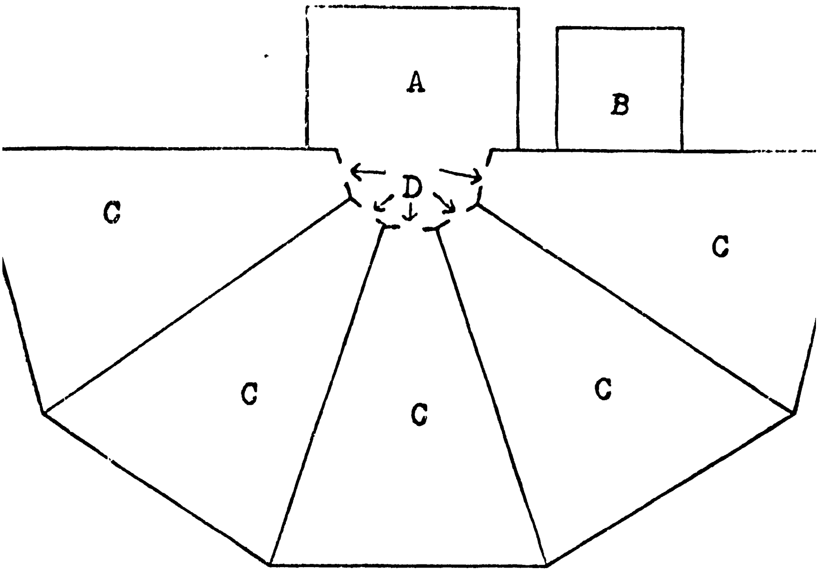
The fruit is fed on to a grading belt, similar to that already described, which carries it before the sorters. Another method is to have rollers, instead of the belt, arranged so as to turn the apples as they are carried forward. The sorters select the

fruit in three grades (for quality) and it then passes to the sizing part. The culls are dropped into a chute and arrangements are made to carry them away. In the sizing part there are three sets of carrying cups (one set for each grade) on endless chains. The apples are automatically fed into these cups one at a time, and are carried along. As they come opposite a tray they are balanced against an apple of the required size. If they are heavier they fall into that tray; if not, they pass on and are tried again at the next tray and so on. The packers then pack from the trays. A machine of this kind requires 20 workers—or more if the crop is poor—and the output varies from 600 to 1,000 boxes per day. Although the packers average perhaps 125 boxes a day, the average *per worker* for all operations is probably about 40 per day of 10 hours. The output depends partly on the quality of the crop, and partly, perhaps chiefly, on the efficiency of the management.

Another type of machine sizes the apples by throwing them through the air, the distance they travel depending on the weight. The apples go into the throwing cups one at a time and are caught in cloth catchers from which they roll into the bins. Now that growers are making a business of grading and packing, it will be necessary to give full consideration to the use of these and other labour saving appliances.

Suitable Method for England and Wales.—In considering the most suitable method for use in this country at the present time, particularly for small growers, it has to be borne in mind that grading for quality is not carried to such a fine point as it has to be in the Western States. There, three grades for quality are made, and the sorter has to consider not only blemishes, but must grade accurately for colour as well. Here less attention is paid to colour, though no doubt we shall do more in this direction later on; the main division is between blemished and unblemished fruit, and it is only the unblemished fruit that requires sizing. Moreover, we have few packers accustomed to select sizes accurately, and some guide in sizing would greatly assist the work, especially when packing in boxes. Various arrangements for dropping apples through holes of varying sizes have been tried, but it must be confessed that it is a somewhat tedious process.

A simple arrangement which would meet these requirements can be made by any grower on a plan such as is shown in the following diagram :—



A is a table on to which the ungraded fruit is poured, with sides 3 in. high to prevent it rolling off. B is a basket or box for receiving blemished fruit, and C are trays (sloping slightly away from A) for receiving the different sizes of unblemished fruit, and D are gaps in the front side of A of widths suitable for gauging the fruit to the different sizes required. The table and trays should be made of canvas on framework and the sizing gaps should be lined with felt. The sorter would stand behind the table A with the ungraded apples in front of him. He would sort the blemished apples into the box B and try the unblemished apples against the gaps D, allowing them to run through into the trays C when they would just go through. The packer would have a box on a rest at the further end of each tray. What promises to be a considerable improvement upon this method is being tried by officers of the Ministry and, if the results prove satisfactory, will be made public later. Some such arrangement would appear suitable for handling a small crop, but where packing on a large scale is to be undertaken, consideration should be given to the American machines.

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METEOROLOGY AND AGRICULTURE.

TOWARDS the close of 1920 the Agricultural Research Council appointed a Committee to consider the data now furnished by the Meteorological Office, to suggest what further data if any might seem desirable, and to make recommendations as to the fuller use of the information available in the development of agriculture and fisheries. The Committee's report, which has been adopted by the Council, is (with the exception of the sections relating to fisheries and international organisation of agricultural meteorology) summarised below.*

There are three ways in which the Meteorological Office assists agriculture, first by providing information as to prevailing or recently prevailing weather, secondly by issuing forecasts of weather to be expected, and thirdly, by research.

Forecasts and Reports for Farmers.—To the practical farmer the second of these methods of assistance is of most importance. Charts are drawn four times daily at intervals of about six hours, and issued with reports and forecasts. The 6 p.m. chart appears in next day's morning papers, while some of the evening papers publish a forecast for the following day based on the 1 p.m. chart. The Daily Weather Report, containing a copy of the 7 a.m. chart together with observations, and giving forecasts for the 24 hours beginning at 3 p.m., is issued at noon. Further, the Air Ministry issues by wireless twice daily, a general statement of the weather conditions and a forecast for the British Isles. In addition wireless reports giving weather observations made only one hour previously at 17 stations in the British Isles are sent out four times in the twenty-four hours in a code to which a key is published.†

Special agricultural forecasts are also issued by telegraph at a small charge. These include regular daily forecasts and notifications of expected spells of settled weather.

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* The Constitution of the Committee was as follows: Sir Thomas Middleton, K.B.E., C.B, LL.D. (*Chairman*), Mr. J. O. Borley, Mr. R. A. Fisher, Mr. J. C. F. Fryer, Mr. R. H. Hooker, Prof. F. Keeble, Mr. H. G. Richardson, Sir Napier Shaw, Dr. G. C. Simpson; Mr. W. R. Black, *Secretary.* A copy of the full report can be obtained on application to the Secretary of the Meteorological Committee, Ministry of Agriculture, 4, Whitehall Place, S.W. 1.

† A pamphlet giving detailed information regarding the use of these wireless messages for agricultural purposes may be obtained from the Air Ministry, Adastral House, Kingsway, London, W.C. 2, from whom information as to telegraphic forecasts may also be obtained.

Of the two remaining forms of assistance referred to above, the records given in the weekly and monthly weather reports, together with the summaries which appear in appendices, cover such data as temperature (at several stations, ground temperature and temperatures of the earth at depths of one and four feet are recorded), rainfall, sunshine and wind; and deviations from the normal are, where possible, noted. To the more scientific agriculturist who may wish to correlate some phenomenon in the growth or health of crops with weather conditions such information, together with the weekly, monthly and quarterly averages given in the Book of Normals, is of obvious value. The Book of Normals is issued in three sections; the fourth, not yet published, will give for selected stations the means and extremes of temperature in greater detail, and also the frequency of days of gale, frost, snow, snow-lying and hail.

The Meteorological Office has not hitherto been in a position to accomplish much direct research in agricultural meteorology. Sir Napier Shaw has, however, carried out several studies, which have been published in the Proceedings of the Royal Society, on the influence of rainfall on, and periodicity in, the yield of wheat, and the Computer's Handbook, issued by the Meteorological Office, contains in Section V, part 3, a number of summaries of papers dealing with the connection between weather and crops.

As regards the needs of the practical farmer the Committee is not of opinion that more could be done at present than is being done; there is no doubt that as and when the progress of science shall render it possible, the Meteorological Office will enlarge the assistance given.

Research.—The research worker is in a different category, and while it is scarcely to be expected that his specialised and detailed requirements could be anticipated by published records, every assistance possible, will, the Committee is assured, be afforded him by the Meteorological Office.

One special department of such research, to which the Committee gave special consideration, was that of plant pathology. Work already done points to a distinct relation between weather and insect and fungus pests. Potato Blight, for instance, and Corky Scab are associated with wet, mildews with dry summers. Unfortunately the biologists' records are as yet very inferior in statistical accuracy to those of the meteorologist. Until, therefore, a sound statistical method has been elaborated for recording

the incidence of plant pests, the existing data as to temperature, rainfall, sunshine and humidity are sufficient for all general needs.

The question of humidity (humidity of the air irrespective of rainfall), is, however, of importance, as there would appear to be no doubt that it has an important bearing on the growth of crops, on insect and fungus attacks and possibly, at times, on the health of live stock. Yet, in the absence at present of definite data, it is impossible to say what types of observations—relative or absolute humidity, dew-point, or readings of the wet-bulb thermometer—would be of most use to agriculturists.

Hourly values and normals for relative humidity are available at four Observatories, but at climatological stations readings are taken twice or at most three times daily, and normals are not issued by the Meteorological Office. Fluctuations in humidity are rapid, records would vary widely at different times of observation, and no satisfactory daily mean could be calculated. If, however, an agricultural investigator, desirous of obtaining humidity normals for any of the stations mentioned in Table IV of the monthly Weather Report, would specify the type of humidity required the Meteorological Office would endeavour to supply them. It may be pointed out that a supplement to the Daily Weather Report contains a useful table of the frequency of minima of surface humidity between fixed limits.

The Committee is of opinion that additional knowledge of the frequency of occurrence of humidity of different values is required; and recommends that special attention should be directed to this subject. Humidity records, unless they are continuous, would be of little use to the agriculturist; if, however, self-recording hygrometers were provided at stations for which records are required, and the total number of hours during which the humidity exceeded, or fell below, given percentages were recorded, the Committee thinks it likely that definite relationships between humidity and the growth and health of crops (or the incidence of diseases) could be established.

Hitherto, in this country, but little use has been made by agricultural science of the observations and records provided by the meteorologist. Abroad the position is different.

In the United States much attention has been given to a study of weather in relation to crops during the past ten or fifteen years. In Russia, before the war, an extensive series of agro-meteorological stations had been developed; while recently stations on the Russian plan have been established in Italy. The

lack of parallel work in our own country may partly be accounted for by the great expansion of studies in other subjects in the past twenty years.

These other studies have taken up the whole time of the investigators for whom provision has been made under the research and educational schemes hitherto adopted in this country. In part, too, the study of weather has received little attention from agriculturists because of the nature of our special problems.

In our insular climate the influence of weather is less sharply defined than in continental areas; and relationships there obvious enough, are here apt to be overlooked. Ideal seasons for wheat, for example, might be indicated in the Middle West of North America or in Russia; but here we find the crop sometimes equally well suited by very different types of weather.

Suggestions for Further Investigations.—Although the general character of our climate may free our harvests from catastrophes, except at long intervals of time, and the fickleness of our weather may make the interpretation of its effects on our crops an elusive study, agriculturists cannot afford to continue to neglect the opportunity for investigation which advances in meteorology have placed at their disposal, and the Committee is of opinion that studies of the folowing three types should now be encouraged.

(*a*) Studies of the relationship between weather and harvests in various districts on similar lines to those followed by Mr. R. H. Hooker.* Such studies, for which much material already exists in weather and crop reports, might lead to the discovery of correlations sufficiently well marked to be of practical assistance in forecasting future yields.

(*b*) As a necessary preliminary to such studies, more complete records will be required as to the state of crops in different districts at different stages of their growth, with special reference to the effect of weather.

It is suggested that observations should be made at specified experimental stations and that the Ministry should arrange for the collation and preservation of these " crop-weather " records.

(*c*) If in future we are able to draw conclusions respecting the yield in particular seasons from the weather records, we must have much more precise information as to what constitutes an optimum sequence of each element of weather for a particular crop and locality.

At present we use accumulated temperature over 42° F. as an index of conditions favourable to vegetation; but accumulated temperature by itself is not enough. American studies have

* The Correlation of the Weather and Crops. Jour. Roy. Stat. Soc. Vol. LXX. Pt. 1., Mar. 1907.

shown how very rapidly the rate of growth of maize falls off above a certain temperature. Until we have similar information for such crops as the oat and the swede, which are often injured by heat, we are not able to interpret the effects of temperature records.

It is the same with rainfall. In certain parts of the country the average weekly rainfall is believed to be near an optimum for oats, but it is not known exactly how near in any particular locality. In East Anglia, for instance, as Mr. Hooker has shown, the spring rainfall is below the optimum, so that there is a marked positive correlation between rainfall and yield from the 13th to the 28th week in each year. No similar correlation has been found in Scotland, presumably because there the average rainfall is near the optimum.

There is need of a study of the requirements of various crops as regards water, temperature and sunshine. Such study must include comparative investigation of soils. It is not enough to ascertain the quantity of water which a plant will require in the normal temperature and sunshine of a given district; we must also know what quantity of water typical soils, differently cultivated, can provide. Such information has hitherto only been available from the Rothamsted drain gauges; now that these have also been installed in Aberdeen data from a new district will be available.

The Committee is convinced that a scheme of observations and records, such as is outlined above, would greatly increase the general interest in the question. For practical farmers it would have an effect comparable to that of a sound system of book-keeping on the financial side of their calling—the effect of co-ordinating and articulating the very considerable fund of knowledge of weather and crops, which, though vaguely and almost unconsciously, is already theirs.

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TRIALS OF NEW VARIETIES OF CEREALS.

PART II.

E. S. BEAVEN,

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PART I of this Paper dealt with the subject of variety testing in general and the present part deals with a method designed to reduce the probable error of the results of trials of new races.

"Half-Drill-Strip" Method.—Every new race under test is separately compared either with an established "standard" race, or with a local race of the same cereal, or with both, hereinafter in either case called the "control." The seed used for all the plots at any station should have been grown and harvested under equal conditions.

The new race and a control race are each grown on ten or more alternating strips of about 1/20th acre per strip—as shown below—where "A" represents the new race and "C" the control.

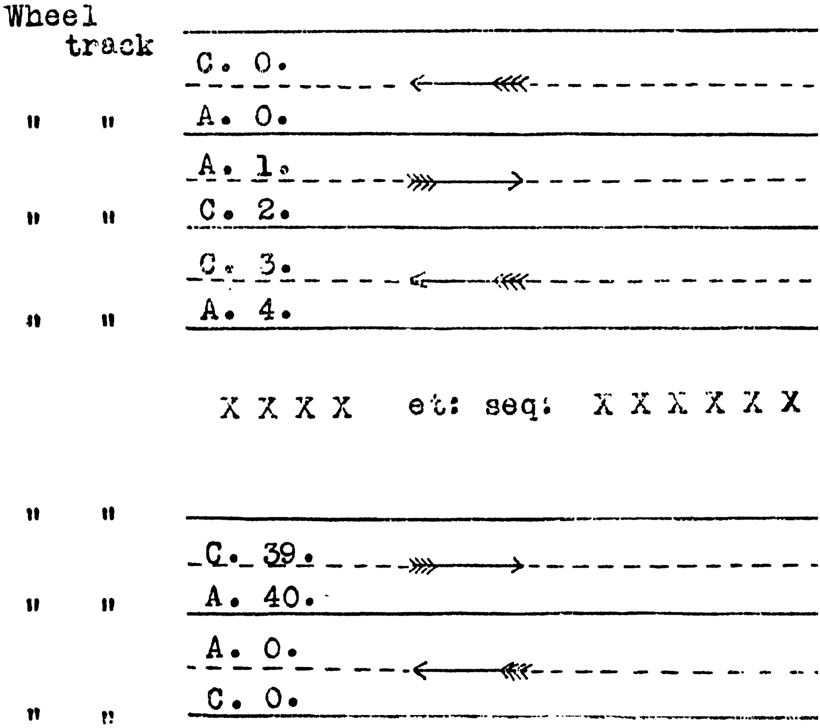

FIG. 1.—Showing Half-drill Strips.

Drilling.—The width of each "variety strip" will be that of the drill employed for seeding. If, as is generally the case with corn-drills, the coulters are an odd number (either 13 or 15 at 7 to 8 in. apart), the centre coulter is put out of action, as is easily done with any make of corn-drill. In the centre of the seed-box a partition is placed: most corn-drills are constructed with a centre partition. One compartment of the seed-box is filled with seed of the control and the other with seed of the new race.

The effect is that after each "turn" of the drill, two half-drill-strips of the same race are seeded alongside, so that when the drill has made 21 "turns" there are 10 drill-wide-strips (20 half-drill-strips) of each race and two half-drill-strips—one at each end of the series. The produce of the two half-drill-strips first drilled at the edge of the field is excluded from the experiment and therefore the weighed produce will be that of 20 half-drill-strips or half an acre of each race. If the series consists of only one race and a control, it will be best to drill 22 drill-strips and exclude one full drill-strip (two half-drill-strips) at each end of the series.

It is necessary that the coulters of the drill should be at precisely equal distances apart, except the two on either side of the centre, where, in the case of a drill with an odd number, one has been put out of action. It is necessary, therefore, to use a drill in which the distances apart of the coulters are adjustable. It is convenient to have something more than a row-space along the lines separating the two races, *i.e.*, in the centre of the drill, but it is imperative that the "over-all" width of the two half-drill-strips should be precisely equal, so that each race gets an equal area. It is also very necessary that all the coulters should deliver the seed at equal depths. The two halves of the drill should in fact be alike in all respects.

The drill should be fitted with a good steerage and the first "turn" should be driven on a marked out line. At each successive turn it should be so driven as to give a uniform space in the line of the wheel-tracks which will be the centre line of each variety strip, dividing each such strip into two equal half-drill-strips. This space should be equal to that in the centre of the drill separating the two races. The effect will be to give each half-drill-strip an equal area with something more than a row-space in the centre of each variety strip, and a similar space between each variety strip; all the spaces being uniform in width. This arrangement is necessary in order to facilitate separation of the races at harvest.

The diagram below shows that with a 13-coulter drill using 12 coulters 7 in. apart, and with 12-in. spaces between the half-drill-strips, the width actually seeded including spaces is 47 in. for each half-drill-strip. The length required to give 1/40 acre per half-drill-strip is therefore in this case 278 ft. If less or more coulters are used the length will be correspondingly altered.

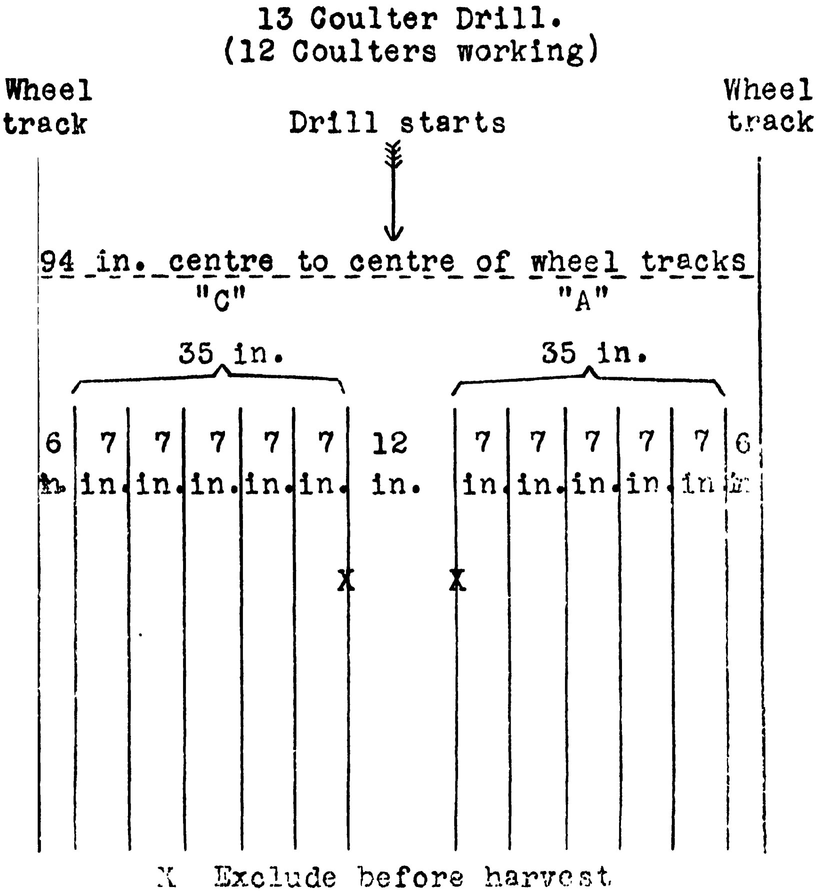

FIG. 2.—Diagram showing Row-spaces.

The above is the length of the strips to be harvested. The lengths to be drilled should be about 9 ft. more, because it is not possible to start and stop the drill exactly on a line, and also the ends must be trimmed to a straight line across the strips before harvest. Obviously, the precise areas seeded are not important provided they are equal and accurately measured. The produce can then be corrected to yields per acre after threshing.

Where the shape of the field is such that strips of twice the above length are more convenient, half the above number of strips of each race may be sown. In this case the length should be somewhat more than doubled and a space of about 10 ft. cut out across the middle of the strips in order to make two sets of 10 half-drill-strips of each race. The full length to

be drilled allowing for this space and for trimming the ends will be about 580 ft. in the case of a 13-coulter drill with 12 coulters working.

Where, as is frequently the case, it is found impossible to avoid placing the trial on land which has been differently cropped or manured in previous years, the strips should, if possible, cross the lines marking the different soil conditions rather than run parallel with them. If possible, the longitudinal direction of the strips should be north and south, or as nearly so as the shape of the field admits.

It will be noted that one acre is required for each race when only one control is used, and two acres for each race when two controls are used, because in the case of two control races the experiment is duplicated in every respect by the addition of the second control race.

Drilling will be found to be much less complicated than would appear from the above directions. Once the drill has been adjusted this goes forward as rapidly as with ordinary drilling. It is quite possible to drill 6 or 8 acres, viz., 6 or 8 separate yield trials in one day if the drill is made ready the day before and if the superintendent is familiar with the method, and has two or three intelligent helpers, one of whom must be an expert drillsman. A good deal of time is occupied in cleaning out the drill (or half the drill where the same control is used for several new races), but no more than when single half-acre plots of each race are drilled. The cleaning out is much more easily done with a drill of the Massey-Harris forced-feed type than with a cup-drill, but a " steerage " is very necessary.

Cutting.—The method to be followed in cutting and in the subsequent operations will depend partly on the state of the crops at harvest time and partly on the degree of accuracy which is aimed at.

A source of systematic error is introduced in all strip methods of comparison if there is " interference " of one race with another along the lines of separation.

In the Warminster trials of 1920 and 1921 the two races compared were of very similar habit of growth—so much so as to be almost indistinguishable at all stages, and it was obvious that there was no interference of one race with the other. The whole of the area drilled, excluding the first and last strip, was therefore harvested and weighed.

In other cases, however, interference will often arise either

from one race overtopping the other; or from lodging across the strips; or from a more active root-system of one race than of the other causing more vigorous growth of that race along each line of division.

It will generally be necessary to make sure of eliminating this possible systematic error. This can be done by cutting out before harvest one row of each race along the lines of separation. This will reduce the number of rows in each half-drill-strip and involve either an addition to the length of the strips or a correction of the figures to give yield per acre. The method of calculating the probable error of the experiment will not be affected. The additional labour will be fairly considerable, but the work can be done well before harvest and will facilitate cutting and harvesting.

If the two races ripen so nearly together that they may be cut on the same day, and if there is not much lodging, the cutting can be done with a " side-delivery reaper " or with a " self-binder " fitted with an adjustment to be referred to later.

If the difference in time of ripening is only a few days, the early ripening race may be left standing till the later is ready for cutting, and in the case of barley this will generally be possible. If, however, the difference is so great that there would be any risk of " shattering " of the grain of the earlier race, the strips must be cut by hand; also, obviously, if there is severe lodging hand-cutting is the only feasible plan. If the lodging is across the plots it may be necessary to go down the spaces between the half-drill-widths with a stave and throw back on either side the produce of each strip in order to make a clean separation immediately before cutting.

The writer's experience of the method has been only with barley and although the straw was very heavy in both 1920 and 1921 in neither year was there any difficulty in cutting with a " side-delivery " reaper. It is, no doubt, more likely to be necessary to cut by hand in the case of oats than of either wheat or barley.

When the plots can be cut with a reaper or binder, if the drilling has been fairly straight, there will be no difficulty in driving the machine so as to cut each half-drill-strip separately. This is facilitated if a man walks behind the machine and warns the driver quickly if he is going astray. The driver should in any case avoid cutting into the next half strip, and if a few plants are left uncut these can be cut by hand and

added to the nearest sheaf before the machine comes round again. It will generally be best to cut only one way of the field for a reason which will appear later.

Binding.—Whether the plots are cut by hand or by a reaper or by a self-binder, the sheaves of the two races must be kept rigidly distinct. The best plan is to use string of two different colours. If a binder is used, a loop of coloured string should be attached to each sheaf of one of the races, before the next turn of the binder.

Field Weighing.—In 1920 and 1921 at Warminster the half-drill-strips of the two races under comparison were cut with a side-delivery reaper—each half-drill-strip separately—and in order to leave approximately the same amount of stubble on all the plots, so that the straw-weights as well as the grain-weights might be comparable, the strips were only cut in one direction.

Machines of this type (now generally superseded by self-binders) have an advantage for this particular purpose:—They throw off two sheaves for each revolution of the rakes, and as the rakes are driven by the travelling wheel each two following sheaves represent the produce of equal areas. In 1921 the area corresponding to each two sheaves was within a negligible fraction equal to 1/500 acre. In this case, therefore, the effect was to split each of the two half-acres into about 250 plots of equal size, and, obviously, it would be possible in such a case to repeat Hall and Mercer's Rothamsted experiment and obtain not only the total weight of both grain and straw on the two half-acres, but also it would be possible to obtain the weight of grain and straw on each 1/500 acre and by this means reduce the probable error of the comparison in respect of both grain and straw to probably a fraction of 1 per cent. This would, however, entail so much labour and supervision as to be practically impossible for a series of plots, and, moreover, would be a "work of supererogation." What was done at Warminster and what is practical was as follows:—As soon as the sheaves had been tied with red and plain string respectively each sheaf was weighed. This was done on a Salter's spring balance graduated to single ounces up to 20 pounds. A balance reading to tenths of pounds would be preferable in order to give a more simple record for statistical purposes. The balance may be suspended from a pole about 6 ft. long carried on the shoulders of two men, and the sheaves weighed two at a time in the order in which they are thrown off by the

machine. The balance should be fitted with a cradle on which the sheaves are placed. The weighing of 500 pairs of sheaves may be performed in about three hours by one assistant reading the weights; one entering them in a prepared book; a man lifting the sheaves on and off the scale; and two men carrying the balance. This operation is therefore feasible for a series of variety trials.

A comparatively simple attachment has been devised for a self-binder in order to deliver sheaves corresponding to equal areas, instead of sheaves of approximately equal weights which is the present arrangement in all self-binders.

If the strips have to be cut by hand, each half-drill-strip may, obviously, with little difficulty be divided into a number of equal plots, and the sheaves on each plot weighed.

The only practical method of collecting the produce is to bulk all the "C" sheaves into one small stack and all the "A" sheaves into another; to thresh the stacks and weigh and record the grain and straw threshed from each stack.

These figures for the total weights of grain and straw on half an acre of each race obviously give no indication of the probable error which attaches to them in the absence of any weighings of the produce of smaller areas, but a very close approximation to the probable error of these weights can be arrived at by a statistical treatment of the sheaf-weights.

It has been found in repeated experiments that the ratio of grain to straw is constant within very narrow limits for the same race when grown under the conditions above described. It may therefore be safely assumed that the probable error of the total grain-weights of each race is not appreciably greater than that of the average total produce on a large number of small areas of each race.

From the tabulation of results in a very large number of similar cases the writer finds that the probable error of the weight of grain is, in fact, less than that of the corresponding weights of grain plus straw.

The object of the half-drill-strip method is to minimise the effect of divergencies in the conditions external to the plant, and there is no doubt whatever that this result is obtained. If the sheaf-weights are determined either for small areas like 1/500 acre by weighing pairs of sheaves, or even only for 1/40 acre half-drill-strips of each race, then the results can be stated in terms of (1) weight per acre of grain, (2) weight per acre of straw, (3) weight per acre of total produce, and (4) probable

error of the weight of the total produce as weighed in the field, and these figures will obviously be much more reliable than a mere statement of the weights of grain and straw on single plots without any indication of the probable error of the comparisons.

The results which have been obtained indicate that, by the half-drill-strip method, the probable error of the difference between the weights of grain of the two races may be reduced to about one-half of one per cent. as against something over five per cent. when single plots are compared.

It is hardly necessary to add that the operations of drilling, cutting, binding, sheaf-weighing, harvesting, threshing and ultimate weighing of grain and straw require a very different type of supervision from that of ordinary agricultural operations and even from that required in field trials as they have usually been conducted, and also involve considerable extra cost.

(As an example of the results obtained by the method described above, the author has prepared a supplement to this article containing tables, with notes, showing in detail the results of an experiment at Warminster in 1921 in which a new race of barley was tested against a control race. The probable error of the results is discussed and their reliability compared with that of a trial with two single half-acre plots of two races. Any reader who is interested may obtain a copy of this supplement, post free, on application to the Ministry).

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WEATHER FORECASTS BY WIRELESS TELEPHONE.

THE following question was asked in the House of Commons on 28th June last:—

Mr. L. Malone asked the Minister of Agriculture whether he is aware of the extent to which wireless telephony is being utilised in France to assist agriculture by broadcasting a weather bulletin twice daily from the national meteorological office; and whether any similar schemes are in contemplation for this country?

Captain GUEST (Air Ministry) replied as follows:—"I have been asked to answer this question. Pending the result of inquiries which are being made, I have no information, other than that which has appeared in the Press, as to the French arrangements for issuing weather forecasts to agriculturists by wireless telephony. The feasibility of using wireless telephony for this purpose in this country is at present under considera-

tion. I may say, however, that the Air Ministry issues daily by means of wireless telegraphy a number of weather reports which could be of considerable use to agriculturists, and with a view to meeting the case of agriculturists and others possessing, or about to instal wireless receiving apparatus, a pamphlet giving particulars regarding these messages and instructions as to their reception and utilisation has been prepared and will be issued in the course of a few days. In addition, the pre-War arrangement by which afternoon forecasts were issued during the harvest season was extended two years ago, so as to enable a farmer, on payment of the cost of telegraphing, to obtain a special forecast at any time which suited his individual need."

The *Journal Officiel* for the 29th June, 1922, contains a description of the system of distribution of weather forecasts by wireless telephone which is now being started in France. Three times daily the Eiffel Tower broadcasting station in Paris will send out a forecast of the weather for the same day and the next day. Communes (roughly corresponding to urban or rural districts in this country) may instal at the public cost a receiving apparatus in a school, police station or at the home of some chosen person, and the messages, which will be received at fixed hours each day, will be communicated in the district by the ringing of a bell—no ringing if there is no change of weather, three strokes to announce rain, six to announce frost, ten to announce storms or hail. The messages can be received by an extremely simple apparatus, the cost of which, including installation, is not expected to exceed 200 francs (about £4 at the present rate of exchange) and the French Meteorological Office has prepared a pamphlet for those who wish to make the apparatus themselves.

Arrangements were made for the distribution of the forecasts to begin on the 15th July. The messages will at present be received only within a distance of about 310 miles from Paris, but arrangements are being considered for distributing the forecasts in the rest of the country by means of district stations.

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REDUCTIONS IN RAILWAY FREIGHT CHARGES.

THE Railway Clearing House has issued a circular, dated 12th July, indicating the reductions in Railway Rates for Traffic conveyed by merchandise trains, which become operative on and from 1st August, 1922. The following extract from

the circular shows the nature and extent of the reductions affecting agricultural traffic :—

Description of Merchandise, etc.	*Rates to be charged.*
	The rates in operation on 14th January, 1920 (except rates operating for specific periods, which periods have expired since 14th January, 1920, or rates which are in force under terms of special agreements), with the undermentioned additions thereto.
1. Coal, Coke and Patent Fuel.	Percentage increase to be further reduced from 75 per cent. to 60 per cent. Flat rate to be further reduced from 3d. per ton to 2d. per ton. Maximum addition to remain at 3s. 6d. per ton. (3s. per ton where now applicable to be retained.)
3. Manure, packed, and lime, packed, in Class C, in loads of 2 tons and upwards, when for use as Agricultural Manure in England and Wales and so consigned.	Percentage increase to remain at 50 per cent. Flat rate to be reduced from 9d. per ton to 4d. per ton.
5. Traffic in Class C of the General Railway Classification other than above.	Percentage increase to be reduced from 100 per cent, to ·75 per cent. Flat rate to be reduced from 9d. per ton to 4d. per ton.
6. Traffic in Classes 1 to 5 of the General Railway Classification.	Percentage increase to be reduced from 100 per cent. to 75 per cent. Flat rate to be reduced from 1s. per ton to 6d. per ton.
8. Live Stock at Truck Rates.	Percentage increase to be reduced from 100 per cent. to 75 per cent. Flat rate to be reduced from 2s. per truck or part truck to 1s. per truck or part truck, irrespective of distance.
9. Live Stock at Head Rates.	Percentage increase to be reduced from 100 per cent. to 75 per cent.
10. Small Parcels (as defined in Part VI. of the Railway Rates and Charges Orders).	Percentage increase to be reduced from 150 per cent. to 100 per cent.
11. Returned empties.	Percentage increase to be reduced from 100 per cent. to 75 per cent.

LABOUR ORGANIZATION ON AN EAST MIDLANDS FARM.

PART II.

ARCHIBALD BRIDGES, B.A.

The Crop Rotation and the Distribution of Labour.—The study of labour organization on the farm would not be complete without a consideration of the distribution of the labour on the crops. The graphs Figs. 1 and 2 will have conveyed the essential requirements in the organization of labour on the whole farm, especially in the relation of stock to arable and the part which "granary" and "establishment" work play in this organization.

Fig. 3 shows the distribution of the manual and horse labour on the arable land for the 1918 crops, with the addition of the work necessary on the twenty-two acres of meadow hay. All work performed from the beginning of cultivation of each crop until it was cleared off the ground is shown. It should be noted that in the case of mangolds no work appears after clamping. The subsequent work of cleaning and carting is considered to be a charge to the stock and is included in the work shown for the sheep and other stock in the previous graphs. The same remarks apply to the turnip crop, but in this case they were mostly eaten off on the ground by sheep, and very little carting work was necessary.

Stress has already been laid on the necessity of the work for live-stock dovetailing with the labour for the cropping system on the farm. Consequently the latter should be arranged, as far as possible, so that each crop in the rotation requires its labour at a different time in order to equalize labour demands and keep the men and horses fully employed. An examination of the principal crops on this farm—winter wheat, barley, turnips and swedes, mangolds, and the mowing and grazing seeds—will show that they largely fulfil the condition laid down as regards labour distribution. The wheat is making its maximum demands in the months of September, October and November, and then requires little attention until the next harvest in August and September. Barley is making its maximum demands in December, January, February, March and April, and again very little further demand until harvest. The root crops are making their principal demands in May, June and July when very little can

be done on the grain crops, and again in November the mangolds are harvested when the principal work on the winter grain crops is over. Mowing seeds only come into prominence at hay time in July, and the grazing seeds require so little labour as to be hardly worth consideration. The whole year, therefore, is provided for with a succession of crops requiring their maximum attention at different periods, such crops being said to be complementary to each other. It is true that the graphs show the complementary crops competing extensively for labour at harvest time, but it is probable that if a weekly chart had been drawn up it would have shown that the harvesting of one crop followed another in close succession and that they were therefore complementary even at this period. The four-course rotation, which has been used here to illustrate the principle of complementary crops, is thus shown to rest on a solid economic basis as far as labour distribution is concerned.

The next point of note in the graphs is that certain crops are demanding attention at the same time, or within a comparatively short period of time. The three spring crops, barley, wheat and oats will serve as an illustration. According to the graph spring wheat made its maximum demands in December and March; spring oats in March and April, in which months also the preparation for and sowing of the barley crop was important. During the succeeding months until harvest, they were more or less demanding attention at the same time. Crops of this nature are said to be competitive. The farmer has a choice, and in selecting from such crops, he should sow that one which adds most to his net profit, a point which he will be able to gauge from experience and the relative yields and prices in the past. Crops competing for labour with the winter wheat are beans and winter oats, and a qualification of the rule as to competitive crops should here be stated. The part which a certain crop plays in the other enterprises of the farm should receive attention. Oats are commonly grown as a food for horses, and beans are a first rate foodstuff for all classes of farm stock. Again the suitability and condition of the land at the time for a particular crop should be considered.

In building up a rotation of crops from the labour point of view, with a given area of land and a given supply of capital equipment, the principle, therefore, should be to make the crops as far as possible complementary to one another, choosing such crops as give the maximum profit, and at the same time

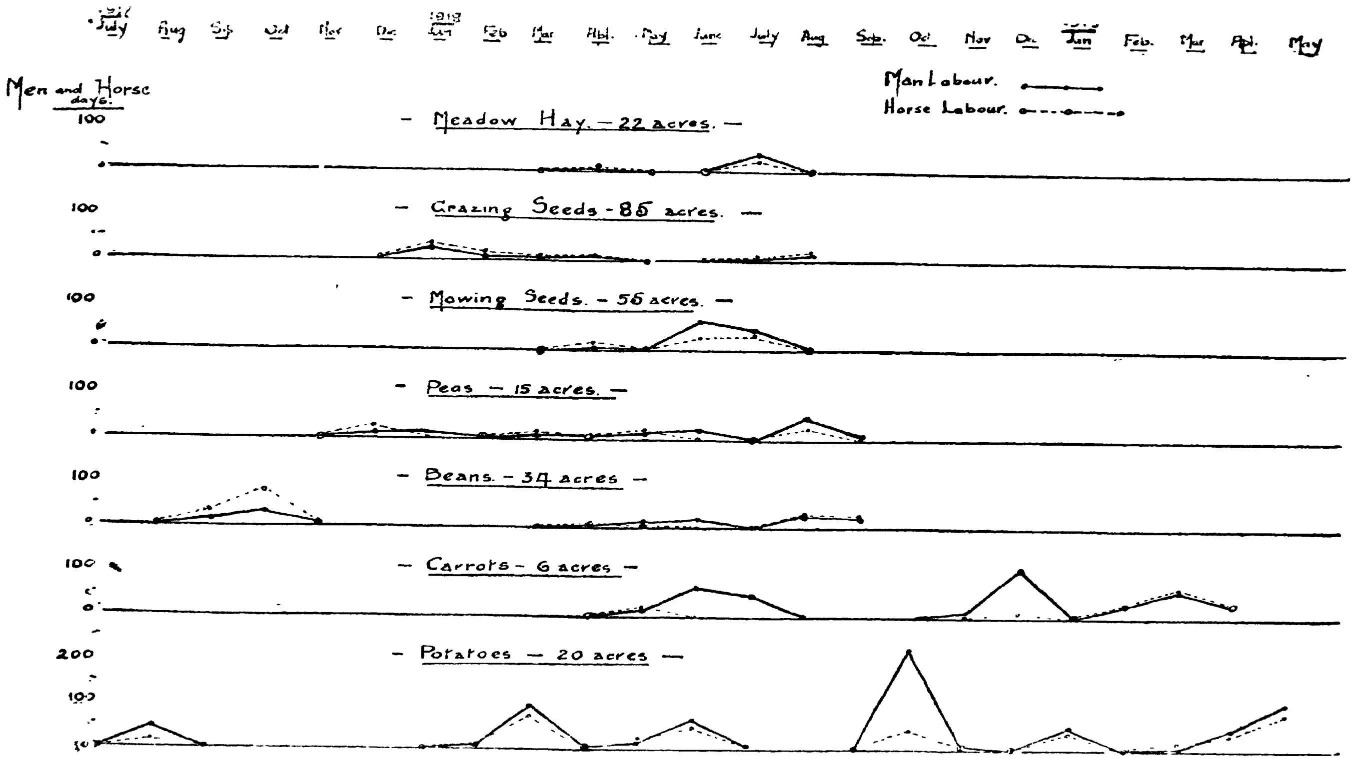
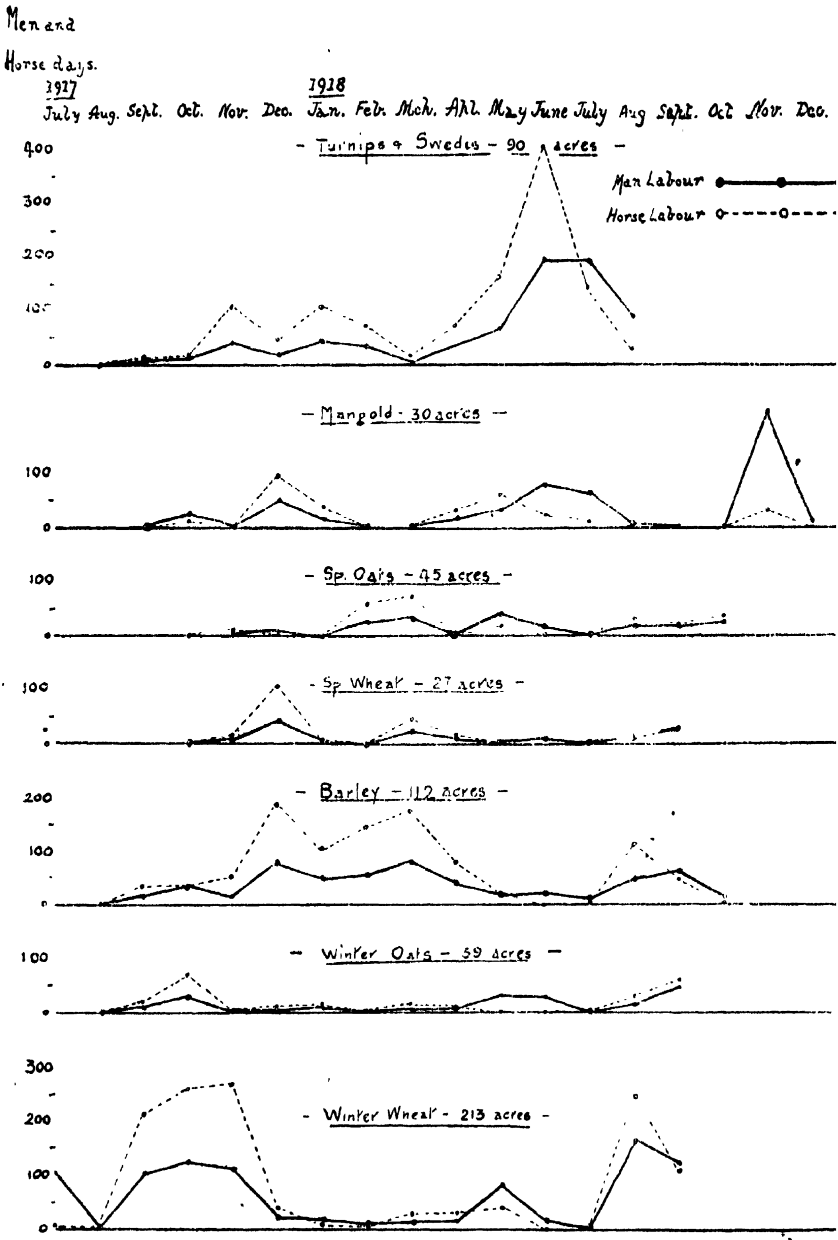


FIG. 3.—Crop 1918. Showing the distribution of Man and Horse Labour, and the competitive and complementary nature of the crops. (Continued on next page.)



Continuation of Fig. 3.

having regard to the other lines of production on the farm which make demands for home-grown produce.

The relative importance of men and horses at different stages of growth should be carefully observed. In the case of the grain crops, the proportion of horses to men is greatest at the time of ploughing and the preparation of the land for the sowing of the corn, where the ratio is approximately two horses to one man. The opposite condition of affairs is seen in May and June when manual labour is of importance.

Another point to note is that certain crops have responded to the use of equipment involving a relatively large use of horse labour to manual labour, while others again require mostly manual labour. In the case of the carrot and potato crops the manual labour line is either above the horse labour line, or is closely associated with it, for the greater period of the growth of the crop. This point will be discussed later. These two crops were distinctly competitive in their nature. Casual labour was necessary for the planting and harvesting of the potatoes, and also for the weeding and thinning of the carrots, a very expensive item. On the other hand, the large amount of productive work which these crops required for their disposal during the winter months, when other work on the land was distinctly slack, compensated to a large extent for the competitive period. It must be remembered, too, that the land is very suitable for the growth of these crops, and naturally this is a large factor in their introduction into the crop rotation.

The pea crop never occupied a large acreage in the rotation, and as the distribution of labour was extremely regular throughout its growth, it did not disturb labour requirements to any extent. The justification of diversity of cropping can also be advanced in its favour. The crop was usually sold off the farm.

Relative Labour Demands of the Various Crops.—It is well known that crops vary considerably in the amount of manual and horse labour they require. The following table compiled from the sum of the monthly totals in the graphs showing the distribution of manual and horse labour and reduced to a single acreage basis for comparison demonstrates this fact. Before discussing this table it should be noted that the figures relating to the grain and pulse crops are up to the point of harvesting only. They are therefore exclusive of the necessary

LABOUR EMPLOYED IN TERMS OF MEN AND HORSE DAYS PER ACRE FOR THE 1918 CROPS.

Crop.		*Acreage.*	*Days per acre.* *Men.*	*Days per acre.* *Horses.*
(*a*) *Arable*—				
Winter Wheat		213	4·35	6·22
Spring Wheat		27	4·08	8·04
Barley		112	4·63	8·73
Winter Oats		39	5·08	6·04
Spring Oats		45	3·71	5·41
Turnips and Swedes		90	8·31	13·56
Mangolds		30	16·73	10·10
Potatoes		20	33·80	19·05
Carrots		6	61·42	26·50
Beans		34	4·00	5·65
Peas		15	7·73	5·60
Mowing Seeds		55	2·18	1·31
Grazing Seeds		85	0·71	1·02
		771		
(*b*) *Pasture*—				
Mowing Grass	22		2·09	1·41
Grazing	172		0·09	0·08
		194		
		965		

(*In the case of the grain and pulse crops the figures shown are exclusive of threshing, dressing and delivery.*)

work for threshing, delivery, &c. Figures were available showing the whole of the threshing and granary work, but unfortunately they were not sufficiently detailed to make a fair distribution to the crops concerned. Steam cultivation work was carried out on seventy acres of winter wheat, thirty-eight acres of spring oats, and twenty-two acres of barley.

The intention here is not to give average figures but to show the extraordinary difference in the amount of labour necessary for each crop. If we take four men-days and six horse-days as the ordinary requirements of an acre of the grain crops up to the end of harvesting and two men-days and one horse-day are added for the subsequent work of threshing, dressing and delivery, making a total of six men and seven horse-days, it will be seen that, approximately, the mangold crop takes two and a half times. potatoes five and a half times, and carrots ten times as much manual labour as the grain crops, and with regard to the horse labour the ratios are approximately 1½, 3 and 4 for the same

crops. The greater bulk of the root crops and their greater manurial requirements, partly explain the large demands which these crops make. The other reason is that they have not yet largely responded to the use of implements. In some crops the manual labour demands are low with relatively large requirements for horse labour. Grain and beans are examples. These are crops for which implements and machinery are largely used, thus greatly reducing the manual labour required in handling them. The opposite condition of things is seen in most of the other crops—the men are relatively more important than the horses—showing that implements and machinery have not yet been devised seriously to reduce the use of manual labour. These facts are well known to farmers, but their general importance in governing the area under any type of crop is not so well realised.

It is easy to handle large areas of crops which are worked by implements, and within limits the area can be increased without largely disturbing the labour requirements. This is well illustrated in prairie farming where manual labour is scarce and dear, and the only crops grown are consequently those on which machinery can be used. On the other hand, with crops needing much manual labour per acre, the area must necessarily be limited, and cannot be increased to any extent unless a much larger supply of labour is obtainable. The question of seasonal distribution has also to be considered, *e.g.*, in the case of potatoes the planting and lifting periods mostly require a supply of labour outside the ordinary resources of the farm.

The question of management must also be thought of. It takes comparatively little effort to direct operations on crops where the manual labour requirements are small, but a much higher standard of efficiency in management is essential for a similar area under the potato or other crop where a large number of labourers must be directed and controlled in their work.

Alternatively, the influence of such crops as the rotation grasses and grazing in reducing the demand for labour should be observed. The total requirements of these crops are very small compared with the other crops on the farm. The greatest reduction will be possible when the land is laid down to grass and grazed only. Seeds hay and meadow hay require an appreciable amount of labour, as the table shows. Where temporary leys are put down the labour demands will depend on the time the land is left down. If the four-course shift is

followed, one-quarter will be in rotation grasses or clovers and three-quarters under the plough. If the ley is left down for two years then the course becomes a five-course shift, and the proportion under grasses is two-fifths and under the plough three-fifths, and, if kept down a third year, then one-half is under grasses and the other half under the plough. Of course the increased stocking capacity of the farm with a greater area under rotation grasses will counteract the tendency to reduce labour requirements, but an acre under grass together with the stock it will carry, should not, unless dairy farming is being carried out, require so much labour as an acre under the plough.

The greatest economy in laying down to grass or having a larger area under ley will probably lie in the horse-labour. The horse-labour requirements are extremely low in comparison with all the other crops, and as stock generally make little demand for horse labour the increased stocking necessary for a larger area of permanent grass or ley would hardly have any influence on the horse-labour requirements.

Labour Requirements of Different Farms.—*Manual Labour.*— It will be evident from the figures supplied in the last table that large variations must occur in the labour requirements of farms. At one end of the scale we have market-gardens employing 12 to 20 persons per 100 acres in the cultivation of small crops with high labour requirements, and at the other end the grazing of sheep where the manual labour falls below 1 person per 100 acres. Between these two cases large variations arise, and to determine with any degree of accuracy the number of hands required on any given farm is one of the most difficult problems of farm management. The land and stock managing capacity of the labourer varies with the size and type of the farm, with the fertility of the soil, the method of cropping adopted and the type of stock carried. It varies also with the implements and machinery at the disposal of the labourer, these to a certain extent determining his efficiency, and this again is closely bound up with the managerial ability of the farmer himself and the capital at his command.

It is probably true that on arable farms, or farms mainly arable, the size of the farm will be the chief factor in determining the land and stock managing capacity of the labourer. As the size of the farm increases implements and machinery can be more extensively and economically used, and the manual labour requirements are therefore smaller in proportion as the size

increases. Here, however, a limit is set, for it would appear that when the size is such as to be unwieldy, having regard to the capacity of the individual farmer, his efficiency as manager may be reduced and the manual labour requirements become stationary or may even rise.

On the other types of farms—dairy, cattle-rearing, cattle-feeding, and mixed farms—the problem is more difficult. It would seem that the fertility of the soil which determines the stock-carrying capacity of the farm will be the limiting factor in labour requirements, but in the absence of sufficient data definite pronouncements cannot be made.

It is true that the larger the farm the greater the tendency to have specialised departments with workers more or less skilled, but here again the departments are never clear cut. If we refer to Fig. 1* it is easy to see that men are shifted from one department to another as required. In the case of sheep a full-time shepherd was employed. but there were very few months in the year in which he alone was able to overtake the work. The demand for labour from October onwards, when the sheep were on roots, was doubled, with a still greater demand at lambing time in March. Even in the early summer when the shepherd did the bulk of the work himself, additional assistance was necessary for washing, shearing and dipping. Similarly with the other stock of the farm. During the summer and autumn when the stock are on grass the labour requirements are at a minimum—an average of little over the time of two men being required during this period. Immediately the stock are brought into the yards and the cows housed for the winter the labour requirements rise at once, falling again as soon as the condition of the weather improves and the growth of grass suffices to maintain the stock out of doors.

What in fact happens on the larger farms is that a skeleton organization of skilled workers in each department is obtained. Outside these a number of general labourers are necessary who may be transferred from one department to another as occasion requires. On the smaller farms the employed man must necessarily be an all-round man.

Horse Labour.—With regard to horse labour the position is more clearly defined. On each type of farm the demand varies considerably, but within each, size is the determining factor in horse labour requirements. The demand per acre varies in inverse proportion to the size of the farm.

* See this *Journal*, July, 1922, p. 322.

The illustrations and principles discussed above demonstrate why proposals for radical changes in agricultural methods are slow to take hold. The principal point to remember in labour organisation is to preserve a proper balance as between the crops and pasture and the stock. Ploughing-up of pasture, or alternatively laying down land to grass, increasing the areas under certain crops, and reducing or increasing the stock, have all to be carefully considered not only in themselves but also in relation to the farm as a whole, and to the capital, equipment, and labour supply at the farmer's disposal.

Good wages are necessary to attract and retain good labour, but good wages can only be paid if the farmer can organize and direct it well, and at times when the margin of profit on farming capital cannot be great, even under the best conditions, success is dependent more upon the farmer's capacity as an organizer of labour than on his standard of knowledge of agricultural science and farming technique.

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COBBETT ON THE CROPS.

SIR HENRY REW, K.C.B.

ABOUT midsummer, a hundred years ago, William Cobbett set forth, after an interval of six months, on his Rural Rides. He spent two days in Hertfordshire and Buckinghamshire and his description of the crops reads as familiarly as an extract from an agricultural journal of to-day. He notes that near "the Wen," by which epithet he persistently speaks of London, the hay was all in rick, because the farmers had the "first haul of the Irish and other perambulating labourers," but that farther out, about Stanmore and Watford, a third of the grass still remained to be cut. He reports a very large hay-crop, which would be sold in London at £3 per load, *i.e.*, 18 cwt. The price of meadow hay in London now is from £5 to £6 per ton. Cobbett interjects the remark, which had a political point long since blunted: "here the *evil* of '*over production*' will be great indeed!"

When he comes to the corn-growing districts of Hertfordshire his observations reveal the mind of the practical farmer. The crops, and especially the barley, are very fine and very forward, although the wheat in general does not appear to be a heavy crop, "the ears seem as if they would be full from

bottom to top." He proceeds: "we have had so much heat that the grain is pretty sure to be plump, let the weather for the rest of the summer be what it may." After referring to his experience in America, where, he states, about fifteen days with the thermometer at 90 degrees, before the ear forms, ensures the maize crop, however unfavourable the weather may be afterwards, he continues: "This tallies with the old remark of the country people in England that '*May* makes or mars the wheat'; for it is in May that the ear and the grains are *formed.*"

Not all the crops he saw impressed him so favourably. About Chesham "the barley, on the land that is not very good, is light, begins to look *blue* and the backward oats are very short," while around High Wycombe, a district which he regards as "an average of England as to corn crops," the wheat would be a fair average crop and very early; barley, oats and peas light; and beans not half a crop. Nevertheless, the farming report generally is optimistic. Already there has been gathered "such a crop of hay as I believe England never saw before"; the sun "will have done more to enrich the land than all the dung-carts" and, "in short, this is one of the finest years I ever knew."

Whether it was due to the fine weather, or the appearance of the crops, Cobbett found rather less cause than usual, in these two Rides, for censoriousness. He girds, it is true, at the Scotchmen whom he found in gentlemen's gardens, and remarks that the division of work among the nations is curious, all the mowers being English and all the haymakers Irish, while the Scotchmen "toil hard enough in Scotland, but when they go from home it is not to *work*, if you please." They leave the back-breaking, sweat-extracting work to others who have less "prudence." This leads to a characteristic apothegm: "The great purpose of human art, the great end of human study, is to obtain *ease*, to throw the burden from our own shoulders and fix it on others." This is, however, the expression of a mood, for at other times Cobbett preached vehemently the dignity, the duty and the happiness of work. But the spontaneity and the inconsistency of the chronicle, which is in fact a spasmodic diary, are the distinction of the Rural Rides.

One reason why the prospect pleased him on this occasion was that he did not see more than three acres of potatoes. These usually excited his vituperation. "Ireland's lazy root"

was one of his mildest descriptions, and it enabled him to combine in the same anathema two of his chief aversions—potatoes and popery. The pigs and potatoes campaign of to-day would have placed Cobbett in a dilemma, for he consistently glorified the one, and condemned the other. It is certain, however, that no dilemma would have long embarrassed him.

The pleasant sight of "the most interesting of all objects," the "neatly kept and productive little gardens round the labourers' houses," which he describes as an "honour to England," give occasion for the comment: "We have only to look at these to know what sort of people English labourers are: these gardens are the answer to the *Malthuses* and the *Scarletts*. Shut your mouths, you Scotch economists; cease bawling, Mr. Brougham, and you Edinburgh Reviewers, till *you* can show us something, not *like*, but approaching towards a likeness of *this*." The pertinence of this sound and fury escapes us now, but it was apparent enough at the time, and we can at any rate recognise it as authentic Cobbett.

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REPORT OF THE INTELLIGENCE DEPARTMENT OF THE MINISTRY.

THE Intelligence Department of the Ministry is charged with duties relating to agricultural education and research, horticulture, the improvement of live stock, the destruction of rats, and diseases of animals. A Report on its work, covering the two years ending 31st March, 1921, which has just been issued,* is therefore deserving of the closest consideration by farmers. The period covered by the report saw the termination of many "war-time" activities, the introduction of many new schemes to meet altered conditions due to the War, and, generally, a big development of Intelligence work to correspond with the increased importance now attached to agriculture by the public. The Report under notice contains not only an account of work accomplished but a statement of the policy underlying it, and is therefore of quite unusual interest.

Agricultural education is carried out by Agricultural Colleges (including University Departments of Agriculture) and by Local Education Authorities. To these bodies the Ministry makes grants-in-aid, and is charged with some responsibility for the proper spending of the money. The Institutions for higher education provide courses of instruction covering two

* Report on the work of the Intelligence Department, Ministry of Agriculture and Fisheries, for the two years 1919–21: H.M. Stationery Office, Imperial House, Kingsway, W.C.2. Price 5/-.

or three years or longer: from the University Departments of Agriculture is recruited the stock of future teachers and experts; while the Agricultural Colleges, offering a slightly different type of instruction, concentrate more particularly on the training of the practical farmer. In both cases, a sound preliminary general and scientific education is required, and the colleges should be entered from the secondary school. There remains the much larger class of small farmers who cannot afford the time for a long course of instruction, but who require some fundamental technical instruction that will put them in touch with the best modern farming methods. This type of instruction comes within the purview of Local Education Authorities, to whom is entrusted the carrying out of the Farm Institute scheme (see p. 400). Twelve Institutes are now in operation (including two established by private benefactions), and in five other cases properties have been purchased for development when funds permit. A general review of other educational activities of Local Authorities, including organised day courses, experimental and demonstration work, etc., is given in the Report, which also contains an account of the various schemes adopted for the agricultural training of ex-Service officers and men.

Research.—The points most noteworthy in regard to agricultural research are the establishment of graded salary-scales for research workers, with security of tenure for the higher grades, and the setting up of a Research Council to secure common action between the research institutes and to obviate duplication of effort. There has been a big all-round development of research activity, and in the case of horticulture and dairying research large capital grants have been paid for the purchase of land and the erection of buildings. The period saw the inception of the National Institute of Agricultural Botany,* a much needed link between the scientific plant breeder and the farmer. The research scheme includes an "advisory service," with specialists in chemistry and plant pathology attached to the Agricultural Colleges to study local problems and to advise farmers on plant diseases and on soil and fertiliser questions. Periodical conferences have been initiated between these advisers and members of the County Staff in their areas, to co-ordinate advisory work and ensure that the ground is well covered. At certain intervals, too, the advisers confer at the Ministry.

* See the account of the Institute in this *Journal*, March, 1922, p. 1072.

Horticulture.—The War revealed the need for greater attention to horticulture, not only because of the increase in small-holdings and allotments, but in connection with the "normal" industry—the large scale cultivation of fruit and vegetables—which greatly needs technical assistance. The Horticulture Division has therefore been enlarged, and a Controller of Horticulture has been appointed, and is assisted by the Horticultural Advisory Council, representing all sections of the industry. Fundamental investigations are conducted at the research stations at Long Ashton, East Malling and Waltham Cross. Demonstration fruit and vegetable plots have been established in most counties under the control of Local Education Authorities. A survey of orchards in the west of England, many of which are greatly neglected, was carried out as a preliminary to demonstrating the need for renovation. By these and other means the standard of horticultural education throughout the country has been raised. Another important side of the work had regard to plant diseases and the administration of the Destructive Insects and Pests Acts, and a full account of the action taken appears in the Report.

Live Stock Improvement.—The Live Stock Branch administers, *inter alia*, the Ministry's live stock and horse breeding schemes, under which grants or premiums are awarded to secure the provision of bulls, boars and horses, and to encourage the keeping of milk records. These schemes have been in operation for some years, and their success in raising the quality of stock and showing the importance of using good sires is generally accepted and appreciated. A marked development in milk recording is reported, records being kept of 61,300 cows in 1919-20 and 38,000 in 1918-19, as compared with 20,000 in the preceding year.

Dairying.—Under the head of Dairying the Report describes the action taken in encouraging the formation of milk depôts, to deal with surplus milk, and of cheese schools, whether travelling or co-operative. The establishment of a co-operative cheese school has in nearly all cases resulted in the local farmers forming a registered co-operative dairy society, with successful results. A small experimental factory at Haslington, near Crewe, was set up to discover whether it is commercially practicable to convert whey (an undesirable by-product in cheese factories) into lactose. The experiment has not gone far enough to justify a decision. Three experimental arable dairy holdings have been established to test the commercial possibilities of

milk production on small holdings of 20 to 30 acres. Much attention has been given to the question of clean milk production, and the desirability of promoting this is being commended to Local Authorities.

Small Live Stock.—Another field for development concerns the small live stock industry—chiefly poultry, rabbits and goats—which was badly organised and to some extent overlooked before the War, but is now recognised as an important source of cheaply-produced food. Education and research are needed, and the Report shows the action taken in promoting such schemes as the Ministry's Egg and Chick Distribution Scheme, and in furthering research into poultry and rabbit problems. The Scheme for the establishment of a National Poultry Institute was originated during the period. The Poultry Advisory Committee, set up by Lord Ernle in 1917, was reconstituted in 1920, the new Committee consisting of six members nominated by the National Poultry Council and three by the Ministry.

Diseases of Animals.—In connection with animal diseases the period was marked by an outbreak of rabies—with a total of 328 cases—which was effectually stamped out, and by the biggest invasion of foot-and-mouth disease which this country has known for 30 years, and which was also successfully dealt with. An important change in the official procedure for dealing with animal diseases is recorded. Before, the administration was entrusted to the Animals Division, while the Veterinary Department dealt with technical matters and research. Research is, however, rapidly discovering alternative methods of control, and the connection between scientific and administrative knowledge grows more intimate. The control and whole conduct of administration have therefore recently been put into the hands of the Chief Veterinary Officer.

Amongst the miscellaneous schemes referred to are the Sugar Beet Factory at Kelham, erected by the Home-Grown Sugar Corporation, half the capital of which was subscribed by the Ministry, and the Methwold estate of 1,500 acres of poor sandy soil, which the Ministry is endeavouring to reclaim.

The above notes show that the Report covers a wide field and should appeal to a large circle of readers. It should be particularly useful to local authorities—whether county committees or governing bodies of colleges and research institutes—to whom the execution of much of the work is entrusted, and without whose whole-hearted co-operation little progress would have been possible.

PROFITABLE EGG FARMING IN THE BASINGSTOKE DISTRICT.

Major C. H. EDEN,
Ministry of Agriculture and Fisheries.

WITHIN the last eleven years there has been, in the Basingstoke district of Hampshire, a remarkable development of commercial egg farming which started when Mr. S. G. Hanson settled there in 1911.

Mr. Hanson had previously been poultry farming in Vancouver, and when he returned to this country he purchased a farm-house, buildings and 10 acres of land, at Kempshott, some 3 miles from Basingstoke, which formed part of a 120-acre farm. The soil is light and on chalk, and although well suited to poultry it had previously given poor returns when worked as a general farm.

At the start Mr. Hanson was watched by many who had had previous experience of poultry and they were doubtful as to what success he would have, but these doubts have long since passed away, his farm soon proving successful.

On the 120 acres which comprised the land belonging to the old farm, many poultry farms of various sizes have now sprung up with land from an acre or less up to 7 acres, supporting from 25 to 30 families. In some cases additional labour is employed so that some 100 people are now provided for on the same acreage which previously only supported 5 or 6 people.

The ideas introduced by Mr. Hanson* differed widely from the methods hitherto in force for poultry keeping in this country. Poultry had not received the same attention as other stock, and although, no doubt, in some cases a profit was made, there was too often a lack of system attended by a great deal of unnecessary labour.

Secrets of Success.—Perhaps one of the chief secrets of the success of the Hanson system is that the main object of the farm is the production of eggs for table purposes, and every attention is given to that end. No attempt is made to produce table birds, in fact in many instances the young cockerels are disposed of as soon as the sex can be detected. Neither is pedigree breeding carried out, the egg farmer relying on the "breeder" farmer to supply him with sittings of eggs, or

* See "Commercial Egg Farming," by S. G. Hanson, published by Constable & Co., which gives a detailed account of the system.

cockerels for mating up his breeding pens with which to replenish his stock.

The breed kept is in practically every case the White Leghorn, which so far has proved the most economical and best suited for the particular object in this district.

Everything is done to reduce labour to a minimum, and in consequence the stock are housed in large buildings of the scratching shed type, up to 600 birds being run in one flock. In one or two cases even 1,000 or more birds are kept in one flock, but the general rule on farms of the larger type is to run the birds in units of 400 to 600.

The pullets are housed apart from the hens and the latter are mated only during the breeding season when fertile eggs are required, it being preferable to produce infertile eggs for consumption, besides which the cost of feeding unnecessary male birds is saved.

Certain conditions stand out as of major importance, one being the necessity for a perfectly dry, light and well-ventilated house, with plenty of scratching litter which must be kept dry. Fowls under natural conditions lay chiefly in the spring and summer, but by providing suitable houses with dry floors and well protected from the weather, it has become possible to obtain an abundance of eggs during the winter, from young stock hatched at the right season. The land required, providing it is of a suitable nature, being fairly dry and well drained, is not great. One acre on this system will be found sufficient for 400 birds, but it must be so fenced that only one half is in occupation at a time, whilst in the run which is " resting " a kale or other suitable crop is grown to serve the double purpose of cleaning the land and supplying green food for the stock.

Incubation and Rearing.—Artificial incubation and rearing are practised, and on many of the larger farms the Mammoth Incubator, heated by means of an anthracite stove, is used. These machines have proved entirely satisfactory and are a great labour-saving device, especially when fitted, as practically all modern machines are, with an egg turning arrangement, whereby all the eggs in one side of the machine can be turned at once by simple movement of a handle outside the machine.

Whilst the system of incubation is practically universal various systems of brooding chickens are adopted. On some farms a large brooder house is installed, heated by means of hot water pipes running through a number of divisions, each of which will accommodate up to 150 chickens. On other farms

a separate unit house, having a capacity for 500 chickens, is used, the heat in this case being provided by a stove and large hover. The fuel used in both cases is anthracite coal.

Success has been obtained by both methods, but on the whole perhaps the majority favour the pipe system. With the pipe system only one fire has to be attended to whereas with the hover it may mean 6 or 8 or even more separate fires to be stoked and attended to, which greatly adds to the labour.

On the other hand, when the hover system is used the house is generally made of sufficient capacity to accommodate the pullets until they are about five months old and ready to be placed in their permanent laying quarters, the land adjoining the house being so penned off that a change of ground can be given, and the land completely rested for seven months of the year.

With the pipe system the chickens up to 6 weeks of age are allowed comparatively small outside earth runs which are only occupied for a short time. They are then thoroughly disinfected and seeded down so as to produce a certain amount of green food whilst unoccupied. After leaving the brooder house, the growing stock are accommodated in small colony houses.

All grain is fed in the house litter, so as to promote exercise, and the mash is given in a dry state, in suitable hovers to prevent waste, a system which reduces labour considerably.

The water supply is a problem on which great care must be bestowed, and whenever possible it is a great advantage to have it laid on in close proximity to the houses, otherwise a large labour bill for carting would have to be faced.

Laying Houses.—The general practice now with regard to the laying houses is to make them somewhat deeper than is recommended in Mr. Hanson's book, 14 ft. being considered about the best dimension. The construction is cheaper, the houses need not be so long, and they are easier to work. It has been found that old Army huts make excellent laying houses. Also, brooder houses for use with the pipe system are now, as a rule, constructed with the roof sloping from front to back. It should be noted that April is considered the most suitable month for hatching out White Leghorns for producing pullets for autumn laying, and as in some seasons the weather is hot during that month, it has been found that the type of brooder house used by Mr. Hanson is apt to become over-heated during the day.

It must be borne in mind that Mr. Hanson laid out his farm in 1911 and others have benefited by his experience, and were he starting again he would no doubt carry out these modifications himself, though the general system would remain the same.

A Successful Modern Egg Farm.—At Woodmancott, some 8 miles from Basingstoke, there is one of the most modern and best equipped commercial egg farms, which is an example of what can be done in modern egg farming. It is owned by Mr. A. F. C. Holdaway, who in 1914 was assisting his father in running a bakery and grocery business in two villages; he was not satisfied with the prospects, and after having an interview with Mr. Hanson decided to start an egg farm. At first he rented 7 acres of land on which he built a Hanson type laying house and retained a laying stock of 600 birds. At the same time he continued his other business. The farm was gradually enlarged until 1919, when the grocery business was disposed of. By this time Mr. Holdaway had built up a plant and stock of 2,500 laying birds, and in addition had obtained the freehold of 21 acres. He was then joined by his father and two brothers, and at one time also had the assistance of a brother-in-law, who undertook a great deal of the work of constructing the plant, but who has since left the farm. In addition to Mr. Holdaway, his father and two brothers, one poultryman and one lad are regularly employed on the farm and one additional casual helper is usually taken on during the busy season in the spring and early summer so that six workers are regularly employed to run the farm.

The plant now consists of four large laying houses. The first one to be constructed was 270 ft. long by 9 ft. wide, but the remaining three are of an improved design, being 110 ft. long by 14 ft. wide, 8 ft. high in front and 5 ft. high at the back. The interior is divided into 10 bays by partitions extending 7 ft. out from the back of the house. Each of these three new houses accommodates 500 birds, and is placed in the centre of 1¼ acres of land which is divided into two runs, the unoccupied portion nearest the house being ploughed up and sown with kale or other forage plants, the remainder being permanent pasture.

A large brooder house has been installed, having a capacity for 3,750 chickens and is heated on the hot-water pipe system. The first portion of the brooder house to be constructed was on Mr. Hanson's design but further extensions were built with

the highest part of the roof in the front. The total length of the brooder house is 170 ft. and it is 12 ft. wide including the attendant's gangway, which is 3 ft. in width. It is divided into 30 compartments or pens to take 125 chickens in each.

The incubator capacity is 4,000 eggs in 400-egg machines of the hot-air type. The attention to these machines absorbs a great deal of time and it is probable that a Mammoth machine will be installed in the near future.

The breed kept is White Leghorn. Incubation commences the first week in March and the last batch of chickens is hatched out at the end of April.

The marketing of eggs in this area is carried out on co-operative lines. In 1912 the Oakley and District Co-operative Society was formed, and now has a membership of about 70. It also deals in food stuffs for the benefit of the members. It is run on somewhat unusual lines, as the eggs are not purchased by the Society from the producers, but the Society finds a market for the eggs and all payments are received and dealt with through the Secretary of the Society, each member notifying the Secretary of the number of cases that he has despatched every time the lorry calls.

A levy of 3d. per case of 30 dozen eggs sent is charged to members to cover administrative expenses. All the eggs are sent to London and the majority go by road transport, which is provided as a private enterprise by one of the members of the Society. The lorry calls at the farms for the eggs and also brings back the empties, thus saving much valuable time to the producer.

It is the aim of the Society to obtain as high a price as possible for the members' eggs, and as these are packed and loaded direct by the producers into the lorry, the working expenses are cut down to a minimum.

Whilst what has been done in this area indicates that poultry farming, if properly organised, is undoubtedly a successful form of agriculture, it should be borne in mind that in common with other businesses it calls for hard work, knowledge, power of observation and business capacity, if the best results are to be obtained. What the future may bring forth it is impossible to say, but so long as there is a sufficient margin between the cost of feeding stuffs and the selling price of eggs, it is a form of agriculture that is capable of development in many parts of the country. In recent years the high price of eggs has doubtless stimulated poultry keeping, but even with a somewhat narrower margin between the price of eggs and the cost of

poultry foods it is anticipated that the stimulus will continue to make itself felt.

The force of example has been the principal feature in the development of modern poultry keeping in this area and there is no doubt that the district and the poultry industry as a whole owe much to Mr. G. S. Hanson in this respect.

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FAILURE OF BLACK YEO OATS IN GLAMORGAN IN 1921.

J. D. DAVIDSON,
Director of Agriculture for Glamorgan, and
PROFESSOR R. G. STAPLEDON, M.A.,
Plant Breeding Station, Aberystwyth.

THE failure of Black Yeo Oats from Herefordshire was reported from 10 farms in the County of Glamorgan, the seed sown on all these farms having come from the same source. Inquiry elicited the following facts :—

1. Black Yeo Oats are a winter variety.
2. Samples drawn from the bulk had been sent to the Official Seed Testing Station and the oats germinated 97 per cent.
3. The appearance of the oats in sample and in bulk was quite normal and gave no evidence of any defect. When the failure of the crop was reported a further sample was tested and this germinated 94 per cent. Approximately 100 acres of this variety of oats were sown in Glamorgan, chiefly in the Vale, in the spring of 1920, and the crop was everywhere a failure.

A point to be noted in connection with the failure of the crop is that it was probably partially due to the weather of 1921. In March the rainfall was about 4.42 in., which practically prevented the sowing of oats on the lias clay soil of the Vale under suitable conditions. April was a very dry month, but the oats started growth and made a little progress in May. During June, however, there was only about 0.15 in. of rain in the Vale, and the oat crop, after making a poor start, became a total failure.

Discussions with farmers who had grown these oats led to the supposition that the grain had been heated, as their experience was that heated samples of oats produce a healthy shoot but weak rootlets. The dry climatic and soil conditions prevailing during the spring did not admit of the oat crop becoming properly established, and the retarding effect of the following dry season was naturally greater on stiff lias clay than on loams and lighter soils.

Samples of the grain were subjected to test at the Plant Breeding Station at Aberystwyth together with a sample of Radnorshire Sprig Oats which had failed to establish itself at that Station. The Radnorshire Sprig, like the Black Yeo, had all the appearance of being a perfectly satisfactory sample—it had no odour and the grain was plump and bright, but in this case the laboratory germination test proved it only to be capable of a growth of 23 per cent.

A laboratory test conducted at Aberystwyth on the Black Yeo confirmed that of the Official Seed Testing Station, but revealed the fact that the energy of germination (germination in three days) was decidedly poor. Microscopic examination of the kernels did not reveal any apparent defect in the embryo.

A pot experiment was consequently made to investigate the matter in greater detail. The procedure adopted was as follows:—The Black Yeo and Radnorshire Sprig were tested against a sample of Culberson as control. The Culberson had given a perfectly normal laboratory germination of 99 per cent., with a high energy of germination, and the lot from which the sample had been drawn had given rise to a thick "stand" and had made good growth on the plots. The seed was sown in 5-in. pots (five seeds per pot). Twenty-five pots constituted a "series." The experiment was set up on 27th June, and subsequently as required one series received "full," i.e., normal watering, and whenever this series was watered a second series was given "half" the normal watering, a third series "quarter" of the normal watering and a fourth series "double" the normal watering.

The chief results obtained are set out in the Table hereunder:

PARTICULARS OF TESTS.	Culberson Control: Laboratory germ. 99 per cent.		Radnor Sprig: Laboratory germ. 23 per cent		Black Yeo: Laboratory germ. 97 per cent.	
	Percentage of seedlings 17 days after planting.	Final percentage of established plants 33 days after planting	Percentage of seedlings 17 days after planting.	Final percentage of established plants 33 days after planting.	Percentage of seedlings 17 days after planting	Final percentage of established plants 33 days after planting.
Normal watering	97	98	16	18	26	91
Half watering ...	97	91	11	11	17	73
Quarter watering ...	75	87	13	14	2	25
Double watering ...	97	86	5	6	38	63
Difference between:						
Full and half watering	0	-7	-5	-4	-9	-18
" " quarter ..	-22	-11	-3	-4	-24	-66
" " double "	0	-12	-11	-12	+12	-28

(−) = decrease and (+) = increase compared with normal watering.

The figures are interesting from several points of view. In the first place they show that differential tests conducted under conditions less favourable to germination and growth than ordinary conditions are competent to reveal defects in a sample that might be overlooked if only the ordinary test was conducted; and in any event to bring out such defects more prominently. Thus with double watering the behaviour of Radnorshire Sprig, relative to Culberson is even more marked than under normal watering.*

It will be seen that the effect of half watering has been but slight on the healthy control sample, but that quarter and double watering have had a very appreciable influence on the percentage of finally established plants—quarter watering in particular having shown a striking decrease in respect of energy of establishment.

In view of the complete failure of Black Yeo under the droughty conditions prevailing during the season of 1921 it is of particular interest to find that whereas Radnorshire Sprig was adversely affected to the greatest extent by double watering, the Black Yeo was affected to the greatest extent by quarter watering. The energy of establishment of Black Yeo under quarter watering was almost negligible and actually less than that of Radnorshire Sprig, although Black Yeo showed a " normal condition " germination of 97 per cent. and Radnorshire Sprig but 23 per cent.

It is thus evident that the seeds of Black Yeo were not normal, and although attaining to a high percentage of germination were defective in some physiological respect which rendered them particularly and exceptionally susceptible to the influence of drought. This showed itself also in the poor energy of germination and of establishment under normal conditions It should be added that the growth habit of the established Black Yeo plants confirmed that this is a Winter Oat.†

The growth of established plants did not differ appreciably either between the three samples or between the differential waterings, except that those subjected to quarter watering were

* These results are in keeping with those previously recorded by Stapledon (Seed Studies : Red Clover, with special reference to the County of Origin of the Seed, *Jour. Agr. Sci.*, X. (1), Jan., 1920), who found that tests conducted with Red Clover at temperatures above the optimum brought out defects of the seed in a very striking manner.

† That this circumstance as such was without influence on the complete failure in Glamorgan is suggested by the fact that black winter oats sown in the spring in the trials at Aberystwyth established themselves normally and produced relatively good crops.

at the end of the month only about half the height of the series receiving normal, half and double watering respectively.

The experiment was not continued for longer than 33 days when all the plants were covered with *Erysiphe graminis* but this in no way influenced the results above referred to.*

In view of the frequent failures of cereal crops that occur in Wales, and in the areas of high rainfall in England, in a year following an adverse harvesting season, the question of the suitability for seed of damaged or apparently damaged grain is an exceedingly important one.

It is possible that the effective damage to the Radnorshire Sprig or Black Yeo may not have been the direct result of heating in the stack or in store, but may have been due to the grain being over kiln dried while in an "unripe" soft and damp condition.

Damage arising out of adverse harvest conditions therefore calls for investigation from two points of view—(1) to endeavour to find out how best to counteract such influences, and (2) to establish a laboratory or other simple and rapidly conducted test upon the result of which it would be possible to form a correct opinion as to the potential crop-producing capacity of the seed.

This question has been under tentative inquiry at Aberystwyth for a number of years; it is, however, always difficult to obtain sufficiently accurate particulars of the conditions which have led to the damage, real or supposed, in respect of samples received.

The clause in the Seeds Act relative to cereals affords very considerable, although, as the case of Black Yeo here discussed indicates, not complete protection. Tests conducted on a considerable number of samples of more or less well known history during the past 8 years at Aberystwyth seem to indicate, however, that in most cases badly damaged samples are incapable of germinating over about 60 per cent. and frequently germinate no more than 10 per cent.†

It is suggested that additional protection would be provided if the energy of germination was always stated, in the case of cereals, on the reports sent out from the Official Seed Testing Stations for England, Scotland and Ireland, and that further

* The pots had of course to be kept in a frame always covered at night and in the day time whenever it rained.

† This view was also borne out by results on samples tested at the Official Seed Testing Station (then at the Food Production Department) in 1917–18. For instance, 6 per cent. of the wheat samples tested germinated below 50 per cent., as did an appreciable proportion of the oat and barley samples.

experimentation on the lines of the differential soil tests here discussed should lead to the establishment of a simple and effective test.

* * * * * *

ANTHRACNOSE OF THE CUCUMBER UNDER GLASS.

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UNDER the name "Spot" disease, the commercial cucumber-grower groups all the leaf diseases of that plant. The most important leaf spot diseases of the cucumber are those caused by the fungi *Cercospora melonis* and *Colletotrichum oligochaetum*, while under conditions of abnormally high humidity *Cladosporium cucumerinum* may be a destructive parasite.

During the years 1897 to 1907 *Cercospora melonis* appeared in the Lea Valley and caused great destruction, but the introduction of the variety Butcher's Disease Resister in 1903, which is immune to this fungus, and of methods of soil sterilisation led to its ultimate disappearance. At the present time *Cercospora melonis* exists only in isolated parts of Great Britain. The *Cercospora* disease was soon followed by another caused by *Colletotrichum oligochaetum*. This is the Anthracnose of cucumbers which is now the most important leaf spot disease of the cucumber in this country, and causes many thousands of pounds' damage each year.

Disease Symptoms.—*C. oligochaetum* has been observed to cause a "damping off" of cucumber seedlings and young plants on several occasions, but this form of the disease is not common. The fungus attacks the young plants at approximately the ground level, and causes a shrinkage of the tissues, so that the plant falls over. It spreads rapidly up the plant and gives rise to spore masses in about five days.

In its commonest form the disease first attacks the leaves and may appear at any time during the life of the plant. It has occasionally been observed during the propagating period, but generally it does not appear until March or April when the plants are well established in the houses and some fruits have been cut. The time at which the plants are attacked bears no relation to their age, but is determined by the presence of suitable sources of infection. On the leaves, the spots generally first appear above a vein, presumably because the spores are washed into

the hollows of the leaf surface by overhead damping. The lesions commence as pale green water-soaked spots barely distinguishable by the untrained eye, but quickly assume a characteristic appearance, becoming dry and reddish brown in the centre with a yellowish water-soaked surrounding zone. The spots vary in shape, being almost circular in areas untouched by any large vein, but irregular patches where they form over a vein. They frequently crack in the centre and the desiccated tissue may not infrequently be beaten out by the daily overhead damping. The spots increase rapidly in size, become more circular and blotch-like, finally coalesce, and the leaf dies At the final stage the leaves have a scorched appearance and are covered with spots.

As the disease advances, lesions develop on the leaf stalks and stems, showing as sunken water-soaked areas which rapidly become dry and powdery. They are usually at first linear in shape but may spread round the stem. Under glasshouse conditions it is not uncommon to see the soft tissues of the stem completely destroyed, leaving the fibrous part exposed, and causing the death of the plant above the point of attack. On stem and stalk lesions abundant spores are produced, giving rise to a pinkish colour which turns black with age.

The lesions on the fruits appear as pale-green water-soaked, sunken areas, the surface of which, owing to abundant spore production becomes pink in colour and finally black. The tissues under the lesion are destroyed and a cavity is produced, which is exposed by the cracking of the surface above. When the leaves are attacked, the health of the plant is impaired only by the serious reduction of leaf area, but lesions on the stem are more serious and may cause the rapid death of the plant by destroying the tissues.

The Organism Causing the Disease.—*Colletotrichum oligochaetum*, Cav., was readily isolated from infections on leaves, stems and fruits. Proof that it causes the disease was obtained by spraying young cucumber plants with a water suspension of spores, and keeping them under suitable conditions

The fungus has been described by Cavara, and later workers. In the present study it has been cultivated on a wide range of artificial media.

Sources of Infection.—The fact that the fungus will thrive upon such substances as new and rotten wood, straw, and cotton wool, provided that these are kept sufficiently moist, led to a systematic examination of glasshouse structures, boxes, wooden tanks, " flats " and heaps of manure.

Material was collected with instruments sterilised by dipping in spirit and flaming with a pocket petrol lighter, and was conveyed to the laboratory in sterilised plugged specimen tubes. The investigations were carried out in nurseries where the disease had never appeared, as well as those badly attacked in the previous year, and examinations were made immediately the crop was removed and also after the houses had received the usual winter treatment prior to the planting of the next month's crop.

The following materials were examined :—

(1) General debris found between the "overlaps" in the glass structure

(2) Samples of decayed wood from holes in "plates," "bars" etc.

(3) Samples of old decayed posts.

(4) Samples of decayed wood from tanks in the houses.

(5) Samples of paper used for filling cavities and packing warped ventilators.

(6) Samples of straw manure from the beds.

(7) Samples of straw manure from the original heap.

(8) Market boxes or "flats."

Part of each sample was examined in the laboratory, while another part was placed in a flask, kept moist for 14 days and shaken up with water which was afterwards sprayed over young cucumber seedlings.

Material from glasshouses where the disease had not occurred previously did not yield the fungus. Materials obtained from diseased houses showed the fungus to be present and young plants were infected by many of the water suspensions tested. The main conclusions may be stated briefly as follows :—

(1) The present methods of cleansing glasshouses during the winter months are not sufficient to exterminate centres of infection of *Colletotrichum oligochaetum* which may exist from a previous diseased crop.

(2) Infection is more abundant immediately after the diseased crop has been removed than after the period of winter rest, but sufficient survives to carry the disease over from one season to another.

(3) The fungus may live occasionally in the debris which collects in the overlap between two panes of glass, but except in old houses this does not form an important source of infection.

(4) The fungus may carry on a saprophytic existence in rotten wood in the house and paper used for blocking holes, and these constitute important sources of infection.

(5) Straw manure removed from beds in infected houses was found invariably to harbour the parasite and when allowed to remain unburnt in a heap outside the houses—a common practice—must be a centre for the spread of the fungus.

(6) The examination of "flats" was unsuccessful in obtaining positive evidence of their transmission of this fungus, but observations upon the incidence of this disease in commercial nurseries indicate the probability that it may frequently be carried in this way.

(7) The examination of straw manure has shown it to be such an important source of infection, that special attention was given to it, and straw manure from the following sources was examined:—

(a) Straw manure fresh from country farms.
(b) Straw manure from country farms after lying in a heap adjacent to a heap of old diseased cucumber plants.
(c) Straw manure from local stables.
(d) Straw manure from London.

The heaps of manure were carefully searched and suspected material taken to the laboratory for further study. Suspensions were also prepared by shaking 1 lb. of manure with 1 gallon of water for five minutes and straining through a fine wire sieve. The liquid obtained was sprayed over young cucumber plants kept in a humid chamber. *C. oligochaetum* was found in nine different samples, and in one of these the pink spore masses appeared on half-decayed straw at the surface of the heap. In no case was the fungus found in manure fresh from country farms or local stables. In five cases it was found in the manure heaps adjacent to those of decaying cucumber remains, and in four cases in manure freshly imported from London stables.

The possible importation of disease in manure from town stables, is important to growers, and especially to those of glass-house produce. Much diseased fruit is sold in East London and Dr. W. B. Brierley, of Rothamsted Experimental Station, informs the writer that cucumbers badly attacked by *C. oligochaetum* are frequently to be seen on street stalls in those parts, the most diseased specimens frequently being thrown into the roadway and trodden under foot. This infection may gain access to stables and thence return to the grower.

The writer's investigations have shown that in nurseries, where *C. oligochaetum* has appeared for the first time, it has in certain cases been imported in the straw manure, and further investigations are necessary to determine the best way of sterilising the manure without reducing its value.

Other important sources of infection are the water supply and the clothes of workers in the infected nurseries, the latter having been found to be a most important method of disease transmission in the Lea Valley.

(*To be concluded.*)

NOTES ON FEEDING STUFFS FOR AUGUST.

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Value of Yellow and White Maize Meal.—During the past year inquiries have been received as to the value of white maize meal and yellow maize meal for stock feeding. As far as our knowledge went at that time, there was practically no difference in the value of these materials for feeding purposes. Recent work in America, however, has shown that our views with regard to these products need some modification. Some experiments were carefully carried out with young pigs as to the value of yellow varieties of corn and white varieties of corn for feeding. In America this is a very important point, since a large area exists in which maize forms the staple product for feeding stock. As a result of these experiments, the following facts were ascertained.

Where there is no pasture or legume hay available, yellow maize is far superior to white maize for feeding pigs weighing less than 100 lb. live weight. The difference in value is assigned to the fact that yellow maize is rich in fat-soluble vitamin, whereas white maize contains too little. Some pigs weighing 60 lb. fed on white corn and skim milk did well for a time, but later developed rickets, which is known to pig keepers as paralysis or rheumatism. All but three in one lot died.

Other pigs, fed on skim milk and white maize until they had got into bad condition, were changed to yellow maize and skim milk, and made rapid recovery, showing rather conclusively that the ration of white maize and skim milk lacked fat-soluble vitamin. On the other hand it was shown by feeding experiments that where pigs have access to pasture, or are given chopped lucerne hay or clover, white maize is as good a feed as yellow maize.

It may therefore be stated generally that white maize is as useful for feeding as yellow maize, except in cases where the general dietary contains little fat-soluble vitamin, when yellow maize will prove of much greater value than white maize.

The Distribution of Vitamins in Farm Produce.—In previous notes, attention has been called to the three principal vitamins, *i.e.*, Fat-Soluble A, Water-Soluble B and Water-Soluble C Vitamin.

DESCRIPTION.	Price per Qr. s.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv. s.	Price per lb. Starch Equiv. d.
Wheat, British	56/6	504	12 11	1 0	11 11	71·6	3/3	1·74
Barley, English Feeding	38/-	400	10 13	0 18	9 15	71	2/9	1·47
„ Canadian No. 4 Western	35/3	400	9 17	0 18	8 19	71	2/6	1·34
„ „ No. 2 Feed	33/6	400	9 7	0 18	8 9	71	2/5	1·29
Oats, English White	37/6	336	12 10	0 19	11 11	59·5	3/11	2·10
„ Black & Grey	36/-	336	12 0	0 19	11 1	59·5	3/9	2·01
„ Scotch White	38/-	336	12 13	0 19	11 14	59·5	3/11	2·10
„ Chilian	29/-	320	10 3	0 19	9 4	59·5	3/1	1·65
„ Canadian No. 2 Western	32/-	320	11 4	0 19	10 5	59·5	3/5	1.83
„ „ No. 2 Feed	28/6	320	9 19	0 19	9 0	59·5	3/0	1·61
„ American	27/-	320	9 9	0 9	8 10	59·5	2/10	1·52
„ Argentine	27/6	320	9 12	0 19	8 13	59·5	2/11	1·56
Maize, „	41/6	480	9 14	0 17	8 17	81	2/2	1·16
„ American	36/-	480	8 8	0 17	7 11	81	1/10	0·98
„ South African	37/-	480	8 13	0 17	7 16	81	1/11	1·03
Beans, Rangoon	8/-	112	8 0	1 15	6 5	67	1/10	0·98
Millers' offals—								
Bran, British	—	—	6 15	1 16	4 19	45	2/2	1·16
Broad Bran	—	—	8 10	1 16	6 14	45	3/-	1·61
Fine middlings (Imported)	—	—	9 15	1 7	8 8	72	2/4	1·25
Coarse middlings	—	—	8 17	1 7	7 10	64	2/4	1·25
Pollards (Imported)	—	—	7 12	1 15	5 17	60	1/11	1·03
Barley Meal	—	—	11 5	0 18	10 7	71	2/11	1·56
Maize „ S. African	—	—	8 10	0 17	7 13	81	1/11	1· 3
„ Germ Meal	—	—	8 17	1 5	7 12	85·3	1/9	0·94
„ Gluten-feed	—	—	8 17	1 11	7 6	75·6	1/11	1·03
Locust Bean Meal	—	—	8 15	0 9	8 6	71·4	2/4	1·25
Bean Meal	—	—	13 10	1 15	11 15	67	3/6	1·87
Fish „	—	—	15 0	5 10	9 10	53	3/7	1·92
Linseed Cake, English (9 % oil)	—	—	12 17	2 6	10 11	74	2/10	1·52
Cotton „ English (5 % oil)	—	—	7 15	2 6	5 9	42	2/7	1·38
„ „ Egyptian (5 % oil)	—	—	7 15	2 6	5 9	42	2/7	1·38
Coconut Cake (6 % oil)	—	—	9 15	1 19	7 16	73	2/2	1·16
Palm kernel Cake (6 % oil)	—	—	7 5*	1 9	5 16	75	1/7	0·85
„ „ Meal (2 % oil)	—	—	6 2	1 9	4 13	71·3	1/4	0·71
Feeding Treacle	—	—	4 15	1 1	3 14	51	1/5	0·76
Brewers' grains, dried, ale	—	—	7 15	1 11	6 4	49	2/6	1·34
„ „ „ porter	—	—	7 0	1 11	5 9	49	2/3	1·20
„ „ wet, ale	—	—	1 0	0 8	0 12	15	-/10	0·45
„ „ wet, porter	—	—	0 15	0 8	0 7	15	-/6	0·27
Malt culms	—	—	8 12	2 3	6 9	43	3/-	1·61

* Prices at Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of June and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 9s per ton. The food value per ton is therefore £8 11s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 3d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·21d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

The effect of absence from food of Vitamin A is retarded growth ending in death, eye disease in some cases, and often onset of rickets.

The absence of Vitamin B leads to retarded growth ending in death, and in poultry, the disease known as "leg weakness."

The absence of Vitamin C leads to the onset of scurvy.

Several inquirers have asked for information as to the best sources from which to obtain these vitamins. Vitamin A is present in fish liver oils, green plants (including lucerne, clover, cabbage and hay), milk, egg yolk, animal fats, and some roots such as carrots, parsnips and mangolds. Vitamin B is present in seeds and grains, generally distributed in the germ and outside layers. It is also present in yeast, milk, egg yolk, green plants, carrots, potatoes, turnips, mangolds and beet. Vitamin C is present in green vegetables, particularly cabbage and its allied species. It is also present in orange and lemon juice, germinated seeds, swedes, turnips, potatoes, tomatoes and milk.

The aim of the farmer should therefore be to arrange his ration so that the diet contains sufficient of the three vitamins. With the table given this should prove an easy matter.

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Kirton Horticultural Station.

ONE of the most important features of the Ministry's scheme for instruction in practical horticulture is the establishment by County Education Committees of demonstration and experimental plots in the chief centres of production. This will enable growers to see the trials of varieties best suited to local conditions and of up-to-date methods of culture and manuring.

In the Holland Division of Lincolnshire the production of potatoes, peas, celery, green vegetables, fruit and flowers has for many years been a most important industry. The need for assisting growers with horticultural advice in the conduct of their industry has led to the establishment at Kirton, near Boston, of a Horticultural Station covering an area of 100 acres. This year there are being carried out trials of potatoes, peas, spring cabbage and cauliflowers, and a start has been made with fruit plots and trials of narcissi, daffodils and tulips.

Seventy per cent. of the area is devoted to vegetable trials, and of these perhaps the most important are those of spring cabbage,*

* See Trials of Spring Cabbage: J. C. Wallace, this *Journal*, March, 1922, p. 1121.

of which some twenty different varieties are being tested under commercial conditions in order to ascertain which are most suited for growing in the county. Manurial trials with cabbage are also being carried out to test the comparative advantages of nitrate of soda, nitrate of lime, sulphate of ammonia, and combinations of nitrate of soda with superphosphate. Fourteen acres are set out for trials of potatoes with the object of testing the comparative cropping capacity of some twenty varieties, and also of testing the value of "once-grown" seed as compared with seed direct from Scotland. Experiments are also in progress comparing the effects of the different potash and phosphatic manures on the potato crop.

The production of peas for drying and packeting green, has for many years been a thriving industry in the county, and nine acres of the trial grounds at Kirton are devoted to trials of varieties of peas with the object of comparing their cropping capacity and determining what are the most suitable manures.

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Admission of Canadian Cattle.—A White Paper (Cmd. 1722, 1922, price 3d.) has been published by H.M. Stationery Office, containing :—

(1) "Extracts from the Proceedings at the Conference of Prime Ministers and Representatives of the United Kingdom, the Dominions and India, 1921."

This is a verbatim report of the discussion at the Imperial Conference at which the Canadian Prime Minister pressed for the carrying out of the assurances claimed to have been given in 1917.

(2) "Memorandum on the Report and Recommendations of the Royal Commission appointed to inquire into the admission into the United Kingdom of Live Stock for purposes other than immediate slaughter at the Ports."

The terms of reference to the Commission are given together with the conclusions arrived at by it.

Export of Dogs to the Channel Islands.—Dogs may now be imported into the Channel Islands from *non-scheduled districts* in Great Britain (*i.e.*, districts in and from which movement is not restricted by Order of the Ministry of Agriculture and Fisheries in consequence of an outbreak of rabies) without undergoing a period of quarantine on arrival, provided they are accompanied by an export certificate from the Ministry of Agriculture and Fisheries (10, Whitehall Place, London, S.W.1) containing a full description of the dog, *i.e.*, breed, sex, age, colour and distinctive markings (if any) for identification purposes, and certifying (1) that the dog comes from an area in and from which the free movement of dogs is permitted, and (2) that the dog is not in quarantine at the time of departure for the Islands.

In addition to the export certificate referred to above the *Jersey Authorities* require that every dog shall be accompanied by a veterinary certificate testifying that it was in good health at the time of embarkation.

In order to obtain an Export Certificate, intending exporters of dogs from *non-scheduled districts* in Great Britain should apply to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1, for the necessary form of application.

Certificates are issued subject to the following conditions, viz., (*a*) that the dogs will be moved to the port for shipment as far as practicable by rail, (*b*) that they will be confined during the movement in a crate, box or other suitable receptacle, and (*c*) that on arrival at the port they will be conveyed without delay to a vessel for shipment.

Certificates are valid for 8 days only, including the date of issue, and must be handed within this period to the Harbour Master, or Deputy Harbour Master, on the arrival of the dog at the port of disembarkation.

With regard to dogs from *scheduled districts* in Great Britain or from *foreign countries*, an application in writing for permission to land the dog in the Islands must be made in the case of Jersey to the Committee of Harbours, Jersey, or in the case of Guernsey, to the States Office, Guernsey, stating the full description of the dog, the place from which it is coming and the port of embarkation. Permission to import the dog, if granted, will be subject to the following conditions, viz., (1) that the dog must be isolated for a period of six months at the Cattle Depôt, Albert Pier, Jersey, or at the States Quarantine Station, Guernsey, at the owner's expense, and (2) that a veterinary certificate must be produced previous to landing to the effect that the dog was in good health previous to embarkation.

A charge of 1s. 6d. per diem at the Cattle Depôt, Albert Pier, Jersey, or of 1s. per diem at the States quarantine station, Guernsey, will be made for food and attention. The respective Channel Island Authorities assume no responsibility as to the health of the dog during the period of isolation.

Foot-and-Mouth Disease.—There have been three further outbreaks of Foot-and-Mouth disease in Great Britain since 22nd June, the date referred to in the *Journal* for July, these outbreaks, which occurred in Derbyshire, Lancashire and Staffordshire, were all in districts already subject to restrictions with the exception of that in Lancashire, which necessitated the imposition of fresh restrictions over an area around Blackpool. The latest of these outbreaks occurred on 30th June. All the affected and in contact animals were slaughtered, the total number being 127 cattle, 78 sheep and 15 pigs.

There has been no further development of the disease up to 21st July, and it has been possible to modify the restrictions very considerably except in respect of the districts immediately surrounding the latest cases.

The total number of outbreaks this year has now reached 1,124, of which 3 occurred in Wales and 102 in Scotland. The total number of animals slaughtered up to 21st July is 23,605 cattle, 21,712 sheep, 9,550 pigs and 48 goats.

Courses at Farm Institutes.

In connection with the article on Farm Institutes in this issue of the *Journal* (p. 400) attention is directed to the following particulars of courses which are held at Farm Institutes recognised by the Ministry. Fuller particulars than those given in the table may be obtained from the officers mentioned in column 5. As accommodation at all Farm Institutes is limited, early application for entry should be made.

County Council (or other body) responsible for Institute.	Name and location of Institute.	Description of Courses.	Fees (Board, lodging and tuition unless otherwise stated.)	Address for further particulars.
ENGLAND. Cheshire County Council.	Cheshire School of Agriculture, Reaseheath, near Nantwich.	(a) Winter Courses of about 22 weeks' duration, in Agriculture and Horticulture. (b) Short supplementary courses during Summer Term. (c) Courses, intended for beginners, of practical training in farm or garden work.	Students resident in county, £1 per week. Other students, £1 15s. per week.	The Principal Cheshire School of Agriculture, Reaseheath, Nantwich.
Cumberland and Westmorland County Councils.	Cumberland and Westmorland Farm School, Newton Rigg, near Penrith.	(a) Winter Course (Agriculture) of 20 weeks October to March, in science and practice of Agriculture with special reference to Dairy-farming and Stock-rearing. (b) Three Summer Courses (Dairying and Poultry-keeping) of from 4 weeks' to 12 weeks' duration. April to September. (c) Special pupils are admitted for practical training in Farm Management.	Westmorland students free. Cumberland students, £1 per week. Students from other counties, £2 per week.	The Principal. Newton-Rigg Farm School, Penrith, or C. Courtenay Hodgson (Secretary), The Courts, Carlisle.
Essex County Council.	East Anglian Institute of Agriculture, Chelmsford.	(a) Winter School of Agriculture of 20 weeks' duration, October to March. *Note.*—There is no farm attached to the Institute. All students previous to attending this course must spend at least one year on a farm, taking an active part in all farming operations. (b) Dairy School. Three courses of from 12 weeks' to 16 weeks' duration. N.D.D. 2 years' course (6 terms); also qualifies for diploma of B.D.F.A. (c) School of Horticulture. Course of three terms, viz., Autumn Term, 3 weeks; Spring Term, 4 weeks; Summer Term, 4 weeks. Practical instruction is given at the County Gardens.	(a) Residents in administrative County of Essex and County Borough of Southend, £5 for 20 weeks. Residents in County Boroughs of East Ham and West Ham, £12 for 20 weeks. Students from outside the county, £1 per week. (b) Residents in administrative County of Essex and County Borough of Southend, nil. Residents in county boroughs as above, 10s. per week. Pupils from outside the county, £1 per week. (c) Residents in administrative County of Essex and County Borough of Southend, nil. Residents in county boroughs as above, 10s. per week. Students from outside the county, 15s. per week.	The Principal, East Anglian Institute of Agriculture, Chelmsford. NOTE.—These fees are for tuition only.

Hampshire County Council.	Sparsholt Farm Institute, near Winchester.	Instruction in Agriculture, Horticulture, Poultry-keeping, Dairying and Bee-keeping. One year's course should be taken in preparation for the B.D.F.A. (Butter and Cheese) certificate examinations. (a) One year's course in above subjects:—Winter Course of 24 weeks, October-March. Summer course of 15 weeks, April-July. (b) Short courses of a few weeks' duration or upwards, in any of the above subjects can be arranged.	Students resident in administrative county of Hampshire, £1 per week. Other students, £1 15s. per week.	The Principal, Farm Institute, Sparsholt, Winchester.
Hertfordshire County Council.	Hertfordshire Agricultural Institute, Oaklands, St. Albans.	(a) One year's course in Agriculture, of three terms, commencing respectively October, January, April. (b) Dairying Courses (i.) One year's course, commencing October. (ii.) Summer Course, April to August. (iii.) Short courses (General Dairying). (iv.) Short courses in Special Dairy Subjects (Clean Milk Production, &c.). (c) Courses in Horticulture. (d) Four weeks' course in Agriculture for non-residential students. (e) One week's course in Clean Milk Production. (f) Courses in Poultry-keeping and Bee-keeping.	Students resident in county, £1 15s. per week. Students from other counties, £2 10s. per week. Day students. 10s. per week.	The Principal, Hertfordshire Agricultural Institute, Oaklands, St. Albans.
Northamptonshire County Council.	Northamptonshire Farm Institute, Moulton, Northampton.	(a) Winter Course of 22 weeks (October to March) in the science underlying the practice of Agriculture. (b) Summer Course, for Women, of 10 weeks (May to July) in Dairy Farming. (c) A limited number of Farm pupils can be taken from April to October for practical training in mixed farming with special reference to Live Stock Husbandry.	Resident pupils:— (1) From Northamptonshire. (a) Winter Course, £1 6s per week. (b) Other courses, £1 10s. per week. (2) From outside the county. (a) Winter Course, £1 15s. per week. (b) Other courses, £2 per week. Non-resident pupils.— (1) From Northamptonshire, 5s. per week. (2) From outside the county, 10s per week.	The Principal, Farm Institute, Moulton, Northampton.
Somerset County Council.	Cannington Court Farm Institute, near Bridgwater.	(a) Agriculture and Horticulture, one year's course, three terms each of 12 weeks' duration. (b) Dairying and Poultry-keeping—Full course, 12 weeks; short courses, 4 weeks.	Somerset students, £18 per term. Other students, £28 per term. (For short courses £1 15s. and £2 10s. per week respectively.)	The Principal, Farm Institute, Cannington, Bridgwater.
Staffordshire County Council.	Staffordshire Farm Institute, Rodbaston, Penkridge, Stafford.	(a) Winter Course in Agriculture or youths from 16-20 years, 22 weeks (October to March). (b) Summer Courses for women in Dairying, Poultry-keeping, Bee-keeping and Horticulture, 11 weeks (April-July).	Fees for Winter Course—Tuition fee, all students, £5; maintenance fee, students resident in administrative county of Stafford, £25; students from outside the county, £45; day students, £7 10s. Fees for Summer Course—Inclusive fee for students resident in administrative county of Stafford, £12; students from outside county, £20.	The Principal, County Farm Institute, Penkridge, Stafford.

County Council (or other body) responsible for Institute.	Name and location of Institute.	Description of Courses.	Fees. (Board, lodging and tuition unless otherwise stated.)	Address for further particulars.
ENGLAND (*cont.*) Trustees of the Earl of Iveagh's Foundation.	Chadacre Agricultural Institute, Hartest, Bury St. Edmunds, Suffolk.	(*a*) Course in Agriculture for male students comprising two Winter Sessions of six months (two terms) each. (*b*) Summer Courses (nine weeks each) in Dairying, Horticulture, Poultry-keeping and Bee-keeping, for women students	Male students—FREE tuition board and residence to class of student for whom the Institute is intended. Female students—resident in the county of Suffolk; tuition and residence FREE board 15s. per week. Students resident outside the county of Suffolk; board residence and tuition 25s. per week.	The Principal, Chadacre Agricultural Institute, Hartest, Bury St. Edmunds.
WALES. Carnarvonshire County Council.	Madryn Castle Farm School, Pwllheli.	(*a*) Winter Course in Agriculture for men (20 weeks), October to March. (*b*) Summer course in Dairying, Poultry-keeping, Bee-keeping and Domestic Science for women (12 weeks, April to July.	(*a*) Carnarvonshire students, £15. Other students, £20. (*b*) Carnarvonshire students, £9. Other students, £12.	The Principal, Madryn Castle Farm School, Pwllheli.
Denbighshire County Council.	Llysfasi Farm Institute, Ruthin.	(*a*) Autumn Course in Agriculture for men (10 weeks), October to December. (*b*) Winter Course in Agriculture for men (10 weeks) January to March, in continuation of (*a*). (*c*) Spring Course in Dairying, Horticulture and Poultry-keeping for women (12 weeks), April to July. (*d*) Summer Course in Dairying f r women (10 weeks), July to September.	Board and lodging, £1 1s. per week. Tuition, £1 16s. per month to Denbighshire students and £3 per month to others.	The Principal, Llysfasi Farm Institute, Ruthin.
Governing Body for administration of William Jones's Foundation.	Monmouthshire Agricultural Institution, Usk.	(*a*) One years' Certificate Course. (*b*) Two years' Diploma Course. Winter Term of 22 weeks (October to March). Summer Term of 22 weeks (April to September). These courses include all branches of Agriculture. Students may specialise in General Agriculture, Dairying, Poultry-keeping and Commercial Horticulture, the last named subject being a particular feature.	Tuition, board and residence:— £15 per session (22 weeks) for Monmouthshire students; £32 10s. for other students. Tuition only:— £2 per session for Monmouthshire students; £5 for other students.	The Principal, Monmouthshire Agricultural Institution, Usk, Newport, Mon.

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXIX. No. 6.

SEPTEMBER, 1922.

NOTES FOR THE MONTH.

The Ministry's Journal.

NEARLY thirty years ago, when Lord Burghclere was President of the Board of Agriculture and Sir Thomas Elliott Permanent Secretary, it was increasingly felt that the Department required some means of reaching agriculturists in order to bring before them Acts of Parliament and the Orders and Regulations of the Board as well as much information of interest and importance which the Board received through official channels, but which it had at that time no means of bringing to the notice of the public. It was decided that the most suitable means would be the publication of an official quarterly Journal and this was finally sanctioned. The first issue was published in September, 1894, and the introductory notice in the first number stated that it was proposed to give publicity through the medium of the Journal to information of interest to agriculturists and that it should record "statistical and other intelligence which could not be reasonably or conveniently inserted in the annual publications of the Department." The condition of agriculture within the Empire and in foreign countries, the results of research at home and abroad, innovations in systems of cultivation, improvements in marketing and distributing produce, farm pests, agricultural statistics, diseases of animals—all these and other matters were to be dealt with.

It was soon felt that a quarterly Journal was unsuitable, as much information which it was desired to issue could not be delayed, and after April, 1897, monthly publication was adopted. Since that date many changes have taken place in the *Journal* in harmony with the extension in the duties and interests of the Department; agricultural education and research have gone forward with a bound, and the influence of progress in this direction is nowhere more noticeable than in the pages of the *Journal*; plant diseases and insect pests were always a prominent feature, though the early issues gave but scant attention either to horticulture or poultry, two branches of agriculture which now obtain a fair share of the limited number of pages available. But perhaps the greatest change which would be noticed if a recent

issue of the *Journal* were compared with some of the early numbers lies in the development of what may be called the practical scientific side; articles by recognised authorities dealing with practical matters are now a pronounced feature of its pages, and it is on these articles, no less than on the notes and articles relating to administrative action, that its success and its real value to the agricultural community depend. During recent years the circulation has doubled and now exceeds 10,000 monthly.

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Milk and Dairies (Amendment) Act, 1922.

THE Milk and Dairies (Amendment) Act, which was passed on 1st August, postpones for a further three years the operation of the Milk and Dairies (Consolidation) Act, 1915, and makes further provision with regard to the sale of milk. Except where otherwise expressly provided, the Act comes into operation on 1st September, 1922.

The Act provides that a Local Authority may, after allowing a hearing, refuse to register or may remove from the register any milk retailer if they are satisfied that the public health is or is likely to be endangered by any act or default of his in relation to the quality, storage or distribution of milk. The retailer has the right of appeal to a Court of summary jurisdiction. A further appeal may then be made by either the Local Authority or the retailer to the next Court of Quarter Sessions, whose ruling is final.

As from 1st January, 1923, milk described as "certified," "Grade A" and "pasteurised" may be sold only under a special licence granted by the Ministry of Health, or under its authority.

The addition of other substances to milk and the sale of reconstituted milk as milk are prohibited.

The sale of milk from a cow suffering from tuberculosis of the udder is prohibited, and if it is proved that the seller knew of, or could with ordinary care have ascertained, the existence of the disease, he is liable to a fine not exceeding £20 for the first offence, and a fine not exceeding £100, or imprisonment, or both, for subsequent offences.

Except as otherwise provided, offences against the Act may render a milk retailer liable to fines of £5 for the first offence, £50 for subsequent offences and a further 40s. per day if the offence is a continuing one. The retailer may also be removed from the register, either absolutely or in respect of any specified premises for a period. At the discretion of the Local Authority,

proceedings may be taken against a servant or agent if they are satisfied that blame does not attach to the employer.

The Act also empowers the Ministry of Health to make regulations as to milk imported for public consumption and as to the labelling and marking of dried, condensed, skimmed or separated milk.

All orders made by the Ministry of Health under this Act* will be laid before Parliament, and orders made after the commencement of this Act under the Contagious Diseases (Animals) Acts will be made with the concurrence of the Ministry of Agriculture and Fisheries.

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Forecast of the Production of Corn Crops.

A FORECAST of the production of the principal cereal crops was issued by the Ministry early in August. Hitherto these estimates have only been issued at the end of October, when results obtained from threshing afford a more certain guide to the produce of the harvest. Practically all the leading countries in the world, however, make estimates in advance of their harvests, and the Ministry decided this year to adopt a similar practice. It will be understood that this forecast, which was made on the 1st August, is necessarily subject to modification owing to weather and other conditions, and this will be particularly the case this year, when bad weather was experienced immediately after the forecast was made. The figures as estimated on the 1st August for England and Wales were as follows:—

	Area (Acres).		*Production (Qr.).*	
	1921	1922	1921	1922
Wheat	1,976,000	1,969,000	8,722,000	7,880,000
Barley	1,436,000	1,362,000	5,309,000	5,090,000
Oats	2,149,000	2,161,000	10,033,000	9,290,000
Beans	237,200	272,000	778,000	920,000
Peas	105,700	123,000	313,000	340,000

The annual preliminary statement of the area under crops and grass and the number of live stock in England and Wales was also issued early in August, and is reproduced on p. 572 of this *Journal*.

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Summer Time.

SUMMER time this year has been fixed by an Order in Council and will end at 2 o'clock on the morning of Sunday, 8th October.

For the future, however, the dates of beginning and ending have been laid down by the Summer Time Act, 1922, which was passed on 20th July last. Under

* Copies of the Act can be purchased through any bookseller or direct from H.M. Stationery Office, Imperial House, Kingsway, London, W.C. 2., price 3d. net.

this Act summer time will start at 2 o'clock in the morning of the day next following the third Saturday in April, or if that day is Easter Sunday, the day next following the second Saturday in April. It will end at 2 o'clock in the morning of the day next following the third Saturday in September.

In 1923, accordingly, summer time will start on Sunday, 22nd April, and end on Sunday, 15th September.

The Act applies only to the year 1923 and will therefore be brought up in Parliament for reconsideration annually under the "Expiring Laws Continuance Bill."

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Farmers' Income Tax.

IN his Budget Statement made on 1st May in the House of Commons, the Chancellor of the Exchequer proposed an important alteration in the assessment of farmers' profits for Income Tax under Schedule B, and by the Finance Act, 1922, these proposals have now become law. Under the Act the profits for the year 1922-23 will be reckoned as equal to the rent or annual value of the land, instead of twice the value, and the position will thus revert to what it was prior to the financial year 1918-19. One effect of this will be that many farmers whose assessed income, under the assessment that has been operative for the last four years, was sufficient to make them liable to Income Tax, will be exempt this year.

Furthermore, if a farmer can prove at the end of the year that he has not made a profit equal to the annual value of his land he can claim to pay on the actual profit, or alternatively he can elect to be assessed under Schedule D, that is, on the average of his actual profits for the three previous years. In both these cases, however, the production of accounts will be necessary in order to show what the actual profits were.

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Weather Forecasts by Wireless Telephone and Telegraph.

IN answer to a question in the House of Commons on 6th July, the Secretary of State for Air stated that the distribution of weather forecasts by wireless telephone would involve a capital expenditure of £5,000 and an annual upkeep of about £1,500. The provision of such a service would, he said, be considered when funds were available.

With regard to the sending out of forecasts by wireless telegraphy the Air Ministry has recently issued a pamphlet*

* *The Wireless Weather Manual*, M.O. 255, published by H.M. Stationery Office, price 9d.

containing particulars of the weather forecasts which are broadcast daily by wireless by the Ministry. The most valuable of these for agriculturists are: (1) a general forecast for the whole country, issued in plain language at 9.50 a.m. and 9.50 p.m.; and (2) forecasts for each of seven areas of Great Britain separately, issued in code three times daily. A key to the code used is given in the pamphlet.

Farmers would find both these valuable, especially at harvest time. The latter, which can be received and decoded in a quarter of an hour, is a forecast for the particular area drawn up a few minutes earlier by a professional forecaster with full information at his disposal.

The apparatus required for receiving the messages is described. A set complete costs about £30, but a user with knowledge of wireless apparatus can construct one from parts at a much lower cost. There are probably, however, in most neighbourhoods amateur wireless operators, some of whom would be glad to "listen in" for the information at the proper times, decode the messages and make them known locally by arrangement.

* * * * * *

Conciliation Committees in Agriculture.

FURTHER wages agreements have been made by Conciliation Committees during the past month, and the total number in operation has now increased to 49.

In Kent, where negotiations were somewhat protracted, the Committee has recently reached the following agreement:—(1) Basic rate of wages for ordinary farm workers of 30s. for 50 hours guaranteed; (2) the recognised working week shall consist of 54 hours: overtime (*i.e.*, after 54 hours) worked at the request of the employer and Sunday labour at 8d. per hour. The agreement operates until the 7th October.

The Committee for the Holland Division of Lincolnshire has extended its previous agreement until the 31st October. The terms of the agreement provide for the payment of 8d. per hour for all hours worked by adult male workers. The settlement of the Rutland Committee makes provision for the payment of 30s. for a week of 50 hours up to the 28th October, to all male workers over 21 years.

In North Berkshire, where previous negotiations between the two sides had failed to solve the wages difficulty an agreement has now been reached to extend up to the 30th September. The terms mutually agreed upon are for the payment of

a rate of 30s. for a week of 50 hours, with 8d. per hour for all overtime.

In addition, the following harvest agreements have been made by the Norfolk and Suffolk Committees:—

Norfolk: During harvest, 1922:—A lump sum of £10 to be paid: the system of working by the harvest or by the month to be as hitherto, or by mutual agreement between employer and workers. Where the harvest is worked by the month it is to be understood that the same applies to 24 consecutive working days—hours not to exceed 70 per week.

Boys to receive proportionate rates.

Suffolk: During harvest, 1922:—(*a*) A weekly wage of 7½d. per hour up to 50 hours; (*b*) a bonus of £4 10s. in addition on completion of harvest; (*c*) the agreement to cover a harvest of 24 days comprising 11 hours per day during cutting and 12 hours per day during carting: (*d*) if the nature of the crops makes it necessary to arrange special terms, provided such terms are mutually agreed, such agreement will not be prejudiced by this agreement.

Particulars of the agreements in any area can be obtained on application to the Ministry.

* * * * * *

The Agricultural Index Number.

THE index numbers of prices of agricultural produce in England and Wales indicate that, as compared with the average of the corresponding month of the years 1911 to 1913, prices in July were generally higher than in June. The average increase as compared with the pre-war years was 72 per cent. in July against an increase of 68 per cent. in June. The following table shows the general increases since the beginning of 1921:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES IN THE CORRESPONDING MONTHS OF 1911-13.

Month	1921	1922
January	183	75
February	167	79
March	150	77
April	149	70
May	119	71
June	112	68
July	112	72
August	131	
September	116	
October	86	
November	79	
December	76	

Fat cattle were very slightly cheaper in July than in June, and fat sheep continued the fall recorded in the previous month's figures. A seasonal fall in sheep prices normally occurs in the late spring and early summer, and the decline indicated by the index numbers does not fully reflect the decrease in prices which

has taken place since April. Fat pigs recovered the fall registered in June.

Cereals were also slightly cheaper in July than in June, as compared with the corresponding months in pre-war years, although in the case of oats the actual average price of 33s. 1d. per quarter in July shows an advance of 2d. on the month. Decreases were also recorded for poultry and for cheese, the latter being due as much to the marketing of new cheese as to any weakening in market values.

All other commodities showed a rise, this being especially marked in the case of milk and butter. Milk showed an advance of almost 2d. per gallon on the month, the average producers' price in July being 11½d. per gallon, while butter advanced by about 3¾d. per lb. The index number for eggs shows a rise of 11 points, in spite of the increase in the average pre-war price with which current prices are compared, and it seems that one of the effects remaining from the high prices of the past few years is the relatively greater violence of seasonal fluctuations in prices.

Although early potatoes were naturally dearer during July than old main crop potatoes had been during June, the July prices of early varieties were relatively cheaper as compared with the pre-war years, than old potatoes had been at the end of their season.

The following table shows the average increases in value of the principal commodities in the past seven months:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

	Jan.	Feb.	Mar.	April.	May.	June.	July.
Wheat ...	44	50	66	57	62	60	53
Barley ...	51	49	46	49	49	58	49
Oats... ...	49	48	53	49	53	57	55
Fat cattle ...	62	67	66	65	70	71	70
Fat sheep ...	60	72	100	128	140	121	107
Fat pigs ..	71	82	85	90	91	82	91
Eggs ...	114	166	95	89	50	69	80
Poultry ...	76	80	77	83	110	116	103
Milk... ...	125	117	92	42	27	28	53
Butter ...	46	41	37	49	54	59	79
Cheese ...	27	33	42	46	48	55	50
Potatoes ...	113	122	112	95	140	80	75
Hay... ...	35	32	32	28	33	35	37

Feeding stuffs showed a general advance in value in July compared with the preceding month, but in fertilisers there was a slight reduction. It is estimated that the average prices of both groups, feeding stuffs and fertilisers, are now between 40 and 50 per cent. above pre-war level.

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LAND DRAINAGE WORKS FOR THE RELIEF OF UNEMPLOYMENT.

C. H. J. CLAYTON, M.Inst.C.E.,
Ministry of Agriculture and Fisheries.

IN view of the exceptional amount of unemployment which existed in the autumn of 1921 a substantial sum was voted by Parliament for additional relief works. At the request of the Ministry a portion of that sum was allocated to drainage works for the purpose of alleviating unemployment among agricultural and other workmen in rural areas which were, in many cases, not provided for under previous schemes.

On 14th and 21st October last, the Ministry issued circulars addressed to Drainage Authorities and County Councils respectively inviting them to submit schemes and estimates for the improvement of drainage conditions within their areas of jurisdiction, for the alleviation of unemployment. The principal conditions laid down were that the work was to be carried out as far as possible by hand labour so as to absorb the maximum number of men; that 75 per cent. of the labour should be recruited from ex-Service men, the balance to be married civilians if available; that the work should be subject to the inspection and general supervision of the Ministry's technical staff; and that proper accounts should be kept.

The whole cost of approved schemes was to be advanced by the Ministry to the Drainage Authorities or County Councils who were respectively to repay to the Ministry within stated periods 25 per cent. and 33⅓ per cent., the latter under guarantee by the owners concerned. In a few exceptional cases repayments up to 50 per cent. of the sums advanced were arranged.

It was recognised at the outset that the winter season was not the most favourable for work in the larger channels, and suggestions were offered as to the possibility of useful work being done in small tributary rivers, brooks, main and tributary drains and field ditches.

Later, the County Councils were invited to submit schemes for water-supply to farms or groups of farms under similar conditions as to labour, but instead of advancing the whole cost of each scheme and recovering a percentage, the Ministry made a free grant in each case not exceeding the cost of unskilled unemployed labour on the scheme, or half the cost of the scheme, whichever was the less.

There were 362 drainage (including sea-defence) schemes, and 48 water-supply schemes submitted and approved, making a total estimated expenditure of nearly £400,000. Of these, 325 drainage or sea-defence schemes and 46 water-supply schemes were actually carried out, providing employment for about 150,000 men-weeks. The wage estimate in each case was based upon the current agricultural rate prevailing in the district, and in drainage and sea-defence schemes the expenditure on tools and materials was restricted to about 20 per cent. of the wage estimate. A small addition for local supervision was also allowed. Of the actual total expenditure, however, approximately 92 per cent. went in the wages of men previously unemployed.

Divisional Areas.—For purposes of inspection and supervision, the country was divided into 6 areas as under:—

Area No. *Catchment Basins.*

1. The Ouse, including the counties of Norfolk, Suffolk, Cambridge, Huntingdon and Bedford.
2. The Weaver, Severn and Somersetshire rivers, and lands to the west thereof, including the whole of Wales.
3. The Alt, Mersey and Yorkshire Ouse, and all lands to the north of their valleys.
4. The Lower Trent, Derwent, Witham, Welland, Nene, Yare, Bure and Waveney.
5. Lower Thames, Medway and the rivers of Suffolk, Essex, Kent and Sussex.
6. Upper Trent, Upper Thames and such areas in the counties of Warwick, Gloucester, Wilts and Dorset as were not otherwise included.

Work was begun in November and continued with comparatively little interruption from bad weather or other causes till towards the end of March, which had been set as the time limit. It soon became apparent, however, that an extension of the period would be required. An extension was sanctioned, first to the end of May and later to the 17th June in the case of Drainage Authorities, and the 30th June in the case of County Councils.

A further extension of time was obtained in the case of certain sea-defence works on the Lincolnshire coast, involving an expenditure of £40,000 and providing employment for about 500 men. This work may not be finished much before the end of October next. In this case 50 per cent. of the cost of the scheme is to be repaid.

Results.—Having regard to the general conditions under which the work was to be done, viz., by men who were

presumably unaccustomed to working in or about watercourses, and especially to the unsuitability of the winter season for such work, no extravagant hopes were entertained as to the value of the results. So little confidence was felt by some of the larger drainage authorities that they abstained from submitting schemes.

The real value of the results actually achieved has been a most gratifying surprise to everyone concerned, and it is easy, after the event, to reflect wisely upon the fact that a large percentage of the men must have served a long and painful apprenticeship, whilst on Military Service, to the art of transforming swamps into "better 'oles."

Apart from sea-defence and water-supply schemes, which are referred to later, the great bulk of the work comprised the thorough clearance of channels by the removal of fallen or ingrowing timber or other accidental obstructions, and the improvement of their sections and gradients by cutting away cesses, bends and shoals, and the digging out of old-established weed roots; in a number of cases the straightening of sinuous courses was effected by the cutting of new channels (see Figs. 1 and 2).

Perhaps the most ambitious effort of the Drainage Authorities was that of the Middle Level Drainage and Navigation Commission, in demolishing an old brick-arched bridge, carrying the road between Wisbech and Downham over the Middle Level Drain at Outwell and building in its place an entirely new structure of steel and concrete (see Figs. 3 and 4). This work was carried out most successfully by Major R. G. Clark, A.M.Inst.C.E., Engineer to the Commission, with direct labour, mostly unskilled, and is in itself an eloquent testimony to the adaptability of all concerned to the conditions under which the work was undertaken.

Other notable achievements by Drainage Authorities were:—By the Welland Outfall Trust, the straightening, widening and deepening of the tidal portion of the River Welland over a length of about 10 miles from its confluence with the River Glen to about 5 miles above Spalding (see Figs. 7 and 8); by the Lugg Drainage Board, the general improvement on similar lines to the above of the main river and its main tributaries over a total length of about 32 miles; by the Ouse Drainage Board, a like improvement of important channels within their system, including those of the Thet, the Brandon, the Ivel and the Old Bedford river; by the Muston and Yedingham Drainage Board in the clearance and improvement of considerable

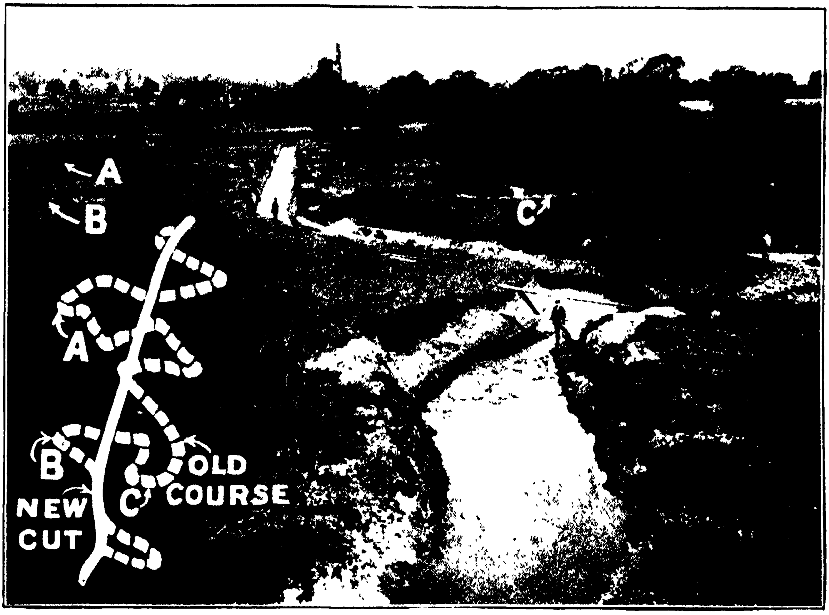

FIG. 1. The River Anker, Warwickshire: A typical case of river straightening.

FIG. 2. Meres Brook, Warwickshire: A typical case of stream cleansing.

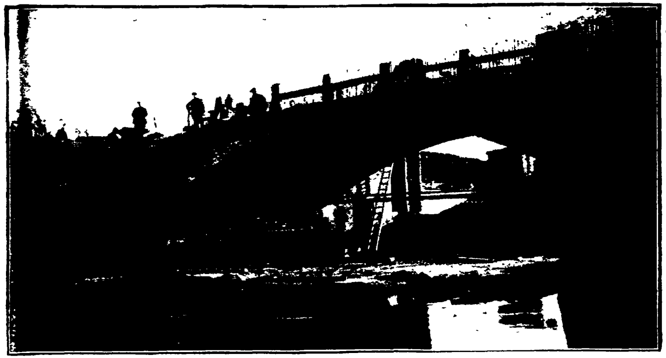

FIG. 3.—Old Brick-arched Bridge at Outwell, Norfolk, in course of demolition.

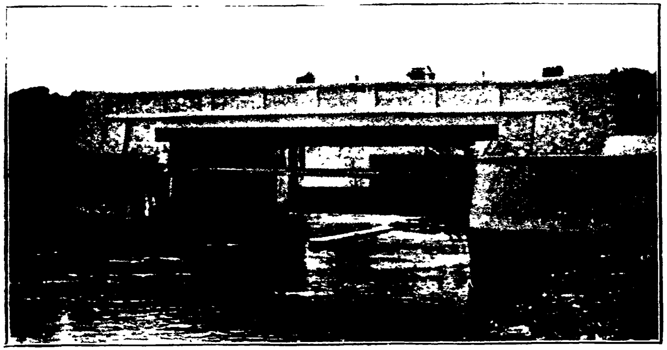

FIG. 4.—New Bridge constructed almost entirely by un-killed labour.

FIG. 5.—The River Derwent, Yorkshire: Arterial Drainage Channel before cleansing.

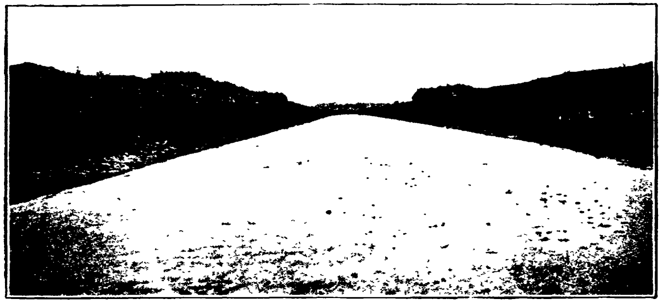

FIG. 6.—The River Derwent, Yorkshire: Arterial Drainage Channel cleared by hand labour.

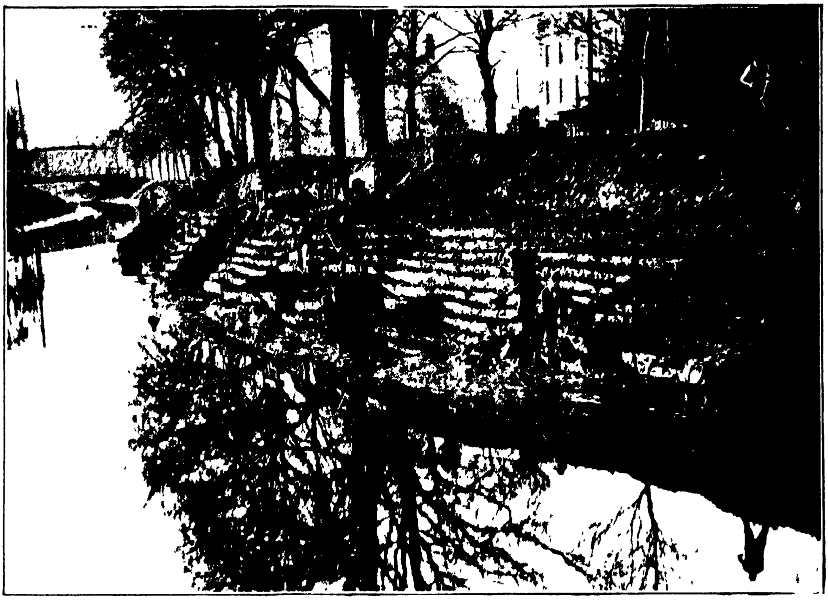

FIG. 7. River Welland at Spalding: Digging out Cesses and widening the Waterway.

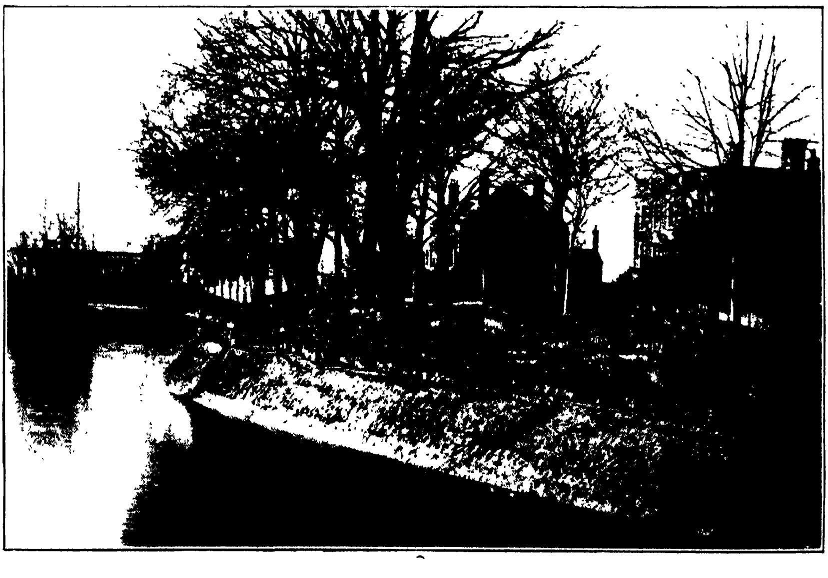

FIG. 8.—River Welland at Spalding: Clearance of Channel completed.

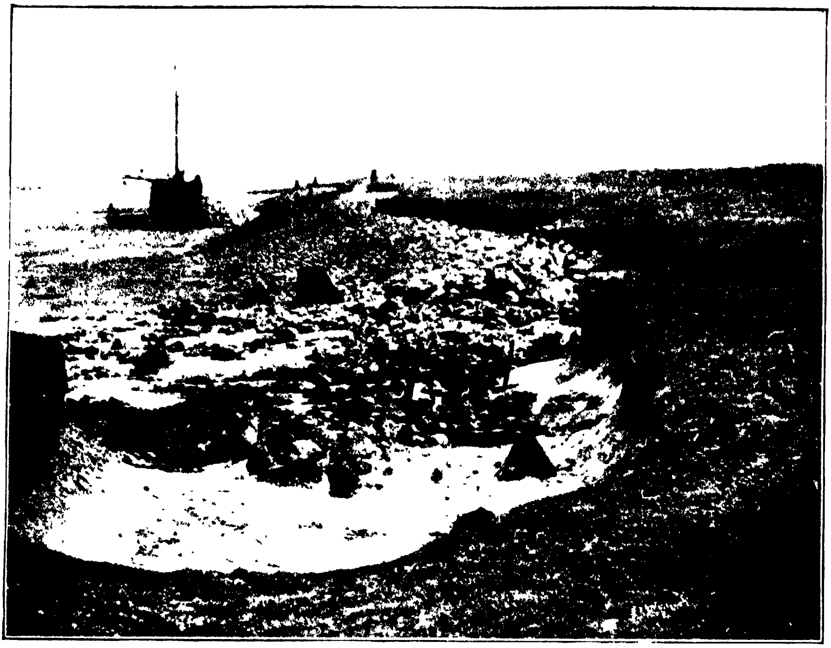

FIG. 9. — Wick Sea-bank, Clevedon, Somersetshire: Showing undermining of Bank by Tidal Scour.

FIG. 10. — Wick Sea-bank, Clevedon, Somersetshire: Showing portion of Bank re-inforced with stone pitching.

lengths of the upper reaches of the River Derwent (see Figs. 5 and 6); and by the Loddon and Blackwater Voluntary Drainage Committee, whose improvements in the channel of the Loddon have been most marked and effective.

A large proportion of the works undertaken both by Drainage Boards and County Councils was for the protection of low-lying land from river or lode flooding by the erection of new or the reconditioning of old flood embankments of which some 70 to 80 miles have been dealt with.

Area No. 6 was responsible for the largest number of schemes submitted by any of the various groups of counties, the total number of drainage schemes being 76 and the total number of water-supply schemes 27, of which 66 and 27 respectively were submitted by the County Agricultural Committees of the counties concerned.

In Kent and Essex one-half the number of cases were for sea-defence. A very high tide which occurred on 1st November did considerable damage to the defences all round these coasts, about 45 miles of sea walls being affected. In a number of cases complete breaches occurred and about 17,000 acres of good grazing land were either actually overflowed or otherwise damaged by sea-water. Practically the whole of the damage has been repaired either by building inset or "shoe" walls round the breaches or by repairing and strengthening the less seriously injured defences.

The same and subsequent high tides in the Bristol Channel seriously menaced the security of about 6,000 acres of land lying behind the Clevedon sea-defences of the Somersetshire Commission of Sewers, and, although no actual breaches occurred, long lengths of the sea-walls were damaged and much of the supporting outmarsh washed away. In this case the walls have been raised and strengthened and their faces and toes protected with stone pitching supported by round timber piling (see Figs. 9 and 10).

Along the coast of Lincolnshire (previously referred to) between Ingoldmells and Mablethorpe, and on the Denbighshire coast at Rhuddlan Marsh, the new sea-defences consist principally of concrete stepwork and timber groyning. In the latter case the work was undertaken by the recently constituted Clwyd Drainage Board—a particularly active and practical body.

Timber groyning was also undertaken along the Pett Level frontage (Sussex) by the Commission of Sewers for the Peven-

sey Levels. Fortunately, this work and the general strengthening of the sea embankment were sufficiently advanced by 13th April to enable the defences to withstand an exceptionally high tide and gale which seriously threatened the works on that date. It has since been stated that, but for the work previously done, the whole of the Level would have been inundated to a depth of several feet with the probable loss of valuable grazing stock and other serious damage to agriculture.

Water-Supply.—Forty-six water-supply schemes were carried out, chiefly in the higher portions of counties where the long drought of 1921 had dried up springs and ponds and emptied wells. They ranged from the building of concrete reservoirs for the impounding of surface or roof-water to the sinking or boring of deep wells and the provision of power-driven pumps. In a few cases hydraulic ram installations were carried out. In practically all these cases, the estimated cost of materials was higher than that of labour, and the Ministry's grant covered the cost of unskilled labour only.

In the case of the Drainage and Sea-Defence Authorities the schemes were prepared and the work supervised by the regular technical officers of the bodies concerned, and these cases show, as might have been expected, better results on the whole than those which were prepared and supervised by County Officers, many of whom would not, of course, claim to be specialists in the kinds of work involved: but when that has been said it remains to be recorded to the high credit of the County Officers that the great bulk of their schemes were well considered, carefully estimated, and remarkably well executed. In the cases where the Councils had retained the services of their Drainage Officers there was almost nothing to choose between Drainage Authority work and County work.

The Men Employed.—Throughout the whole of the operations and in every part of the country the spirit displayed by the men has been excellent. A few isolated stories have been told of "street-corner boys" who have refused work at 32s. a week when they could get three-quarters of that amount for lounging, but 95 per cent. of the men have been only too anxious to be employed and there have been many hundreds of cases of men cycling or tramping many miles to and from work daily in all weathers rather than accept the dole or outdoor relief. The total number of men who have been engaged upon the works at one time or another cannot be less than

11,000, and there has not been the least trouble with them anywhere. The largest number employed during any single week was 8,165 for the week ending 6th May.

Where the site of the works has been within a short radius of an urban centre a fair proportion of townsmen have been employed, but taking the country as a whole, a summary of the Inspectors' reports indicates that from 80 to 90 per cent. of the men were genuine agricultural or other rural workers.

Analysis of Cases.—The following table gives an analysis of the cases dealt with in the various areas and the acreages estimated to have been benefited by the works:—

Area No.	No. of Cases.			Submitted by :		Totals.	Approx. Number of Acres benefited.
	Drainage.	Sea Defence.	Water Supply.	Drainage Authorities.	County Councils.		
(1)	44			36	8	44	39,700
		Nil		—	—	—	—
			2	—	2	2	—
2)	63			31	32	63	14,600
		7		4	3	7	10,500
			2	—	2	2	—
(3)	25			9	16	25	29,000
		3		—	3	3	2,500
			3	—	3	3	—
(4)	51			35	16	51	95,800
		2		2	—	2	12,000
			2	—	2	2	—
(5)	22			14	8	22	73,800
		32		8	24	32	17,100
			10	—	10	10	—
(6)	76			10	66	76	16,600
		Nil		—		—	—
			27	—	27	27	—
Totals	281	44	46	149	222	371	341,600

It will be observed that the number of drainage, sea-defence and water-supply schemes carried out by County Councils numbered 222 and that those carried out by Drainage Authorities numbered 149. The division of costs was not, however, in similar proportion, for whereas the total estimated cost of County Council cases was £83,000 or an average of about £374 per scheme, the total estimated cost of Drainage Authorities' schemes was £299,000 or an average of about £2,000 per scheme.

The actual expenditure on all cases will have fallen short of the total estimates by about £45,000, owing to a certain number of approved schemes not being proceeded with and to others having been carried out below the estimated cost. Exact figures, however, are not yet available. Taking the total expenditure at £338,000 to £340,000 it is interesting to note that this would represent just about £1 per acre over the areas benefited.

* * * * * *

A "CLEAN MILK" CENTRE AND WHERE TO FIND IT.

Major H. P. G. Maule, D.S.O., M.C., F.R.I.B.A.,
Ministry of Agriculture and Fisheries.

Articles in the July and August issues of this *Journal* have dealt with the plans and descriptions of new cow houses and farm buildings designed expressly for the purpose of producing milk under the best and most modern hygienic conditions. To many practical farmers struggling under the present adverse economic conditions such plans, involving considerable capital outlay, may seem a counsel of perfection which it were folly to pursue, but from the number of inquiries since received from various parts of the country, including Scotland, seeking further information, the writer is encouraged to hope that the subject may be further exploited without fear of loss of interest.

It is obvious that at the present time capital outlay on a large scale for farm buildings must be limited to comparatively few undertakings while, on the other hand, the heritage of the War with the enforced neglect of repairs and the high cost of building since 1919 have combined to retard the improvement and repair of existing buildings, though such are now urgently needed to ensure better and more profitable results from dairy farming.

The recent fall in the cost of building prices is naturally tending towards a revival of building activity; especially in making good long-neglected repairs, and the opportunity may now come to many to effect such slight alterations or additions to existing premises as may well enable the farmer to revolutionise his methods of milk production at very small capital outlay.

In many cases both landlords and tenants are unaware of the comparative ease and cheapness with which the adaptations can be made, and the necessary apparatus for sterilizing uten-

sils installed, for, as has been pointed out in this *Journal*, the human element is the most important factor, and elaborate buildings and costly fittings are not essential for the production of clean milk, provided that the arrangements are such as reasonably conduce to increased care and personal interest in the work on the part of the farm hands.

A recent visit to various farms in the Reading district undertaken under the auspices of the staff of the National Institute for Research in Dairying proved most instructive and convinced the writer that, given the requisite knowledge of what is essential, adaptation of existing buildings for the purpose of producing clean milk is a simpler and less expensive undertaking than many people are apt to imagine.

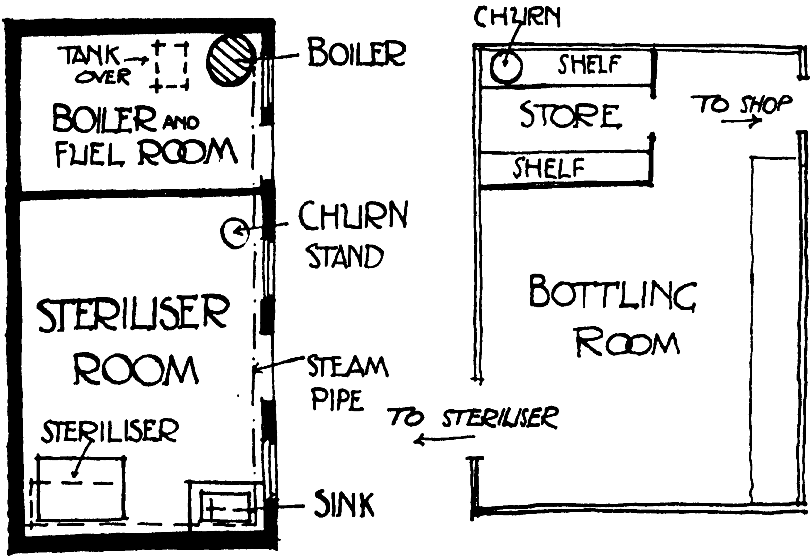

Fig. 1 Old Stable adapted for Sterilizing Plant.

The purpose of this article, therefore, is to describe by means of rough sketch plans some of the small but significant improvements recently carried out at several old farms of the ordinary type, whereby the production of Grade A milk has become the normal procedure.

Fig. 1 illustrates the premises of Mr. J. J. Davis, of Reading, retailer of Grade A milk, and is instructive as showing how existing buildings may be adapted to entirely new purposes at small cost with profitable results. The plan shows an old stable converted into a boiler house and sterilizing room. The boiler, by Jenkins, of Rotherham, cost £35 complete and gives 50 lb. head of steam per square inch, 10 lb. being sufficient to

sterilize churns. This is placed in a separate compartment with water feed tank above, ample storage place for fuel being also available.

In the remainder of the building the plan shows the positions of the churn stand, sink, and galvanised iron sterilizer, the latter being 4 ft. 6 in. long by 2 ft. 6 in. wide and 2 ft. 6 in. high, to all of which steam is laid on from the boiler and controlled by the necessary valves.

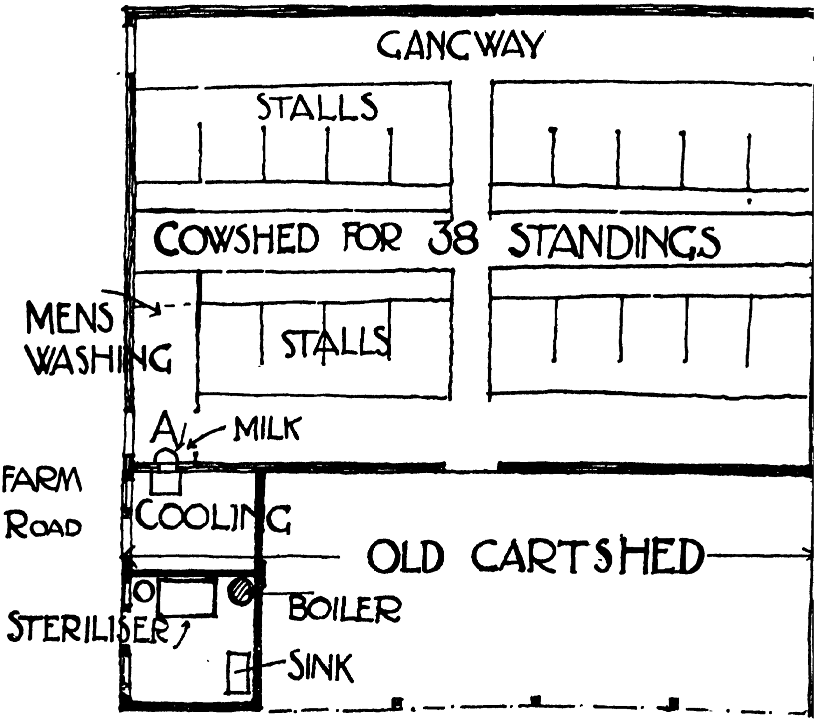

Fig. 2.—Hartley Farm, showing New Dairy.

Whitewashed walls, an impervious and easily cleaned floor and ample light complete the sterilizing equipment, which was carried out at a total cost of about £120.

A bottling room with small store room containing shelves for bottles, labels, caps, etc., is provided in an adjacent building. At the present time about 125 gallons of milk are handled per day. The simplicity and efficiency of this small plant are worthy of more general imitation.

Fig. 2 shows the improvements carried out at Hartley Farm for Mr. Bullingham, where Grade A milk is now regularly produced. The case is typical of the ease with which maximum

improvement in methods of production can be attained with the minimum disturbance of existing buildings.

In this case an existing double cowhouse had a lean-to cart shed adjoining, of which use was made to obtain the necessary dairy accommodation. The sketch plan shows how by the sacrifice of two stalls in the cowshed, a men's washing and overall room has been provided with direct external access. Here also the milk is weighed before it is poured into the receiver (marked A on the plan) which conveys it to the cooler in the adjoining but isolated cooling room.

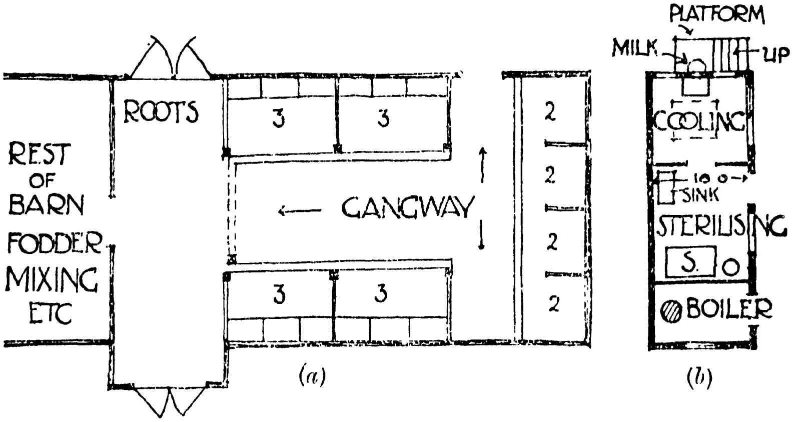

FIG. 3. -Beansheaf Farm: (a) Old Barn converted into Cowshed; (b) New Dairy.

The dairy has been formed by cutting off one bay of the old cart shed and dividing it into two portions. Nearest the cowshed but quite cut off from it, is placed the cooling and clean utensil room with ample light and direct external access. Adjoining is the sterilizing room, only 11 ft. by 10 ft., containing the boiler, sink, sterilizer and churn stand. Perhaps a slight improvement might have been made by isolating the boiler, giving access to it from the cartshed and thus minimising risk of dust and making the sterilizing room more convenient for working purposes, but the scheme as it stands is extremely simple and workable and has been carried out with the lowest expenditure in building costs.

Some 40 cows are kept, necessitating the employment of four milkers and one cleaner, and the instructive thing about this farm is the fact that the essential alterations for the proper and scientific production of Grade A milk, affecting such a large herd, could be made with so little disturbance to existing

buildings and yet be so adequate in effect as to revolutionise the methods of production.

Fig. 3 shows buildings at Beansheaf Farm, in the occupation of Mr. Cumber, where Grade A milk is also produced; it is instructive from two points of view.

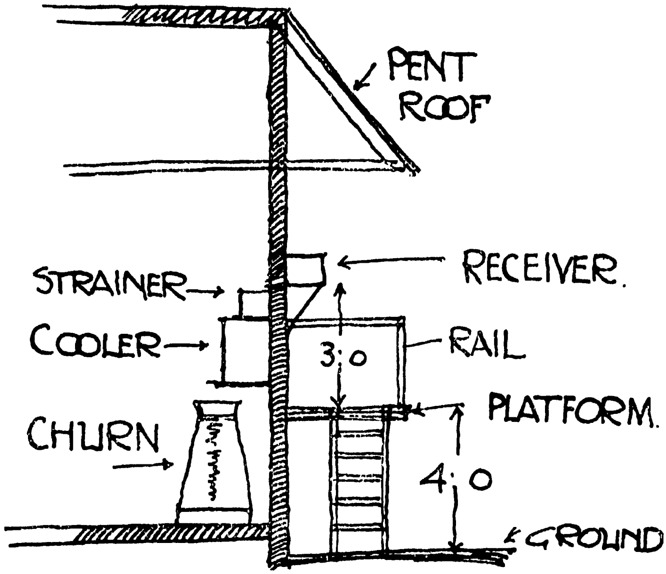

FIG. 4.—Beansheaf Farm: Section through Cooling Room.

In the first place the principal cowshed, containing standings for 20 cows, has been constructed out of a typical old-fashioned straw barn, and the cow standings generally, giving accommodation for some 40 cows in all, have nothing especially to distinguish them from thousands of others, save, perhaps, the care with which they are kept clean and the attention which is paid to hygienic detail.

In the second place, at this farm, it was found necessary to construct an entirely new dairy, yet the over-all size of this building, sufficient for the adequate handling of the milk of 40 cows, some 90 gallons per day, is only 30 ft. by 11 ft. 6 in., and owing to the scattered nature of the plan of the old buildings, it could not be placed with equally convenient access from all the cow sheds.

This point is emphasised in order to draw attention to the statement already made that the production of clean milk is not dependent upon elaborately planned modern buildings.

The dairy is placed conveniently for access from the main road and in close proximity to the adapted straw barn. The

accommodation comprises a small boiler house and fuel store, well lighted and placed at the opposite end of the building to the cooling room. Between these two, and with direct access to the cooling room as well as the roadway, is placed the sterilizing room containing the usual sink, steriliser and churn stand, the over-all size being 12 ft. by 10 ft.

Above the cooling room is placed a water storage tank. At the end is an external raised platform 4 ft. from the ground with pent roof over, and 3 ft. above this, on the end wall of the building, is the receiver through which the milk is poured into the strainer and cooler inside. A rough section (Fig. 4) shows the arrangement.

Approximately, some 90 gallons of milk are dealt with daily and the results so far thoroughly justify the outlay upon this efficient little building.

In conclusion, it may be said that the chief impression gained by this most instructive visit was the fact that in each case the best results in milk production have been secured by the simplest and most direct means. Nothing elaborate or costly has been done and what has been successfully attained might with equal ease be attained elsewhere, where the physical conditions of buildings and surroundings call for improvement.

It is impossible not to ascribe this improvement in the production of pure milk to the spread of education and the pervading influence of the National Institute for Research in Dairying, and it is hoped that the publication of these notes may induce others to follow the lead so ably set in the Reading district.

*   *   *   *   *   *

THE SHIRE HORSE:

PAST, PRESENT AND FUTURE.

EDMUND BECK.

HAVING been invited to write an article on Shire horses for the Ministry's *Journal*, I propose to deal with the subject under the three headings, the Past, the Present and the Future.

The Past.—It will not be necessary to dwell on the past, for many able writers have dealt with the genesis of the Shire, tracing his ancestry to the Great War Horse that carried the knight to battle in the days when knights were bold. It may, however, be noted that in 1879 a Society was formed and a Stud Book instituted to further the breeding of the English Cart Horse, which then took the name of the Shire Horse. The society proved an immediate success and many of the ablest men in the country, both landowners and farmers, took up the breed and set about its improvement.

At that time, although the Shire was a weighty horse it must be admitted that there was considerable room for improvement, especially in his feet, legs and movement. A marked change, however, soon took place. Lincolnshire Lad II and his famous son Harold, What's Wanted and his son Premier, William the Conqueror and his sons Prince William and Hitchin Conqueror, Royal Albert, Bar None, Vulcan and Bury Victor Chief were all famous sires that did their bit in the earlier days of the breed. In later days Lockinge Forest King, Childwick Champion and Norbury Menestrel proved their worth, and it is interesting to students of pedigree to observe how full these three are of the blood of the old giants. Lockinge Forest King had three crosses of Harold, one of Premier, one of Prince William, and two of Royal Albert; Childwick Champion had three crosses of Lincolnshire Lad II and one of Premier; and Norbury Menestrel was of the combined blood of Hitchin Conqueror, Premier, Harold, Royal Albert and Vulcan. Other famous sires up to and including the present are Champion's Goalkeeper, Friar Tuck IV, Babingley Nulli Secundus and Champion's Clansman. The breed has produced many other good sires. It is only an expression of opinion, but if asked to say which of these sires has done most for the breed the writer would say that Lockinge Forest King holds chief place by reason of the beautiful mares and fillies that he sired, all of one type.

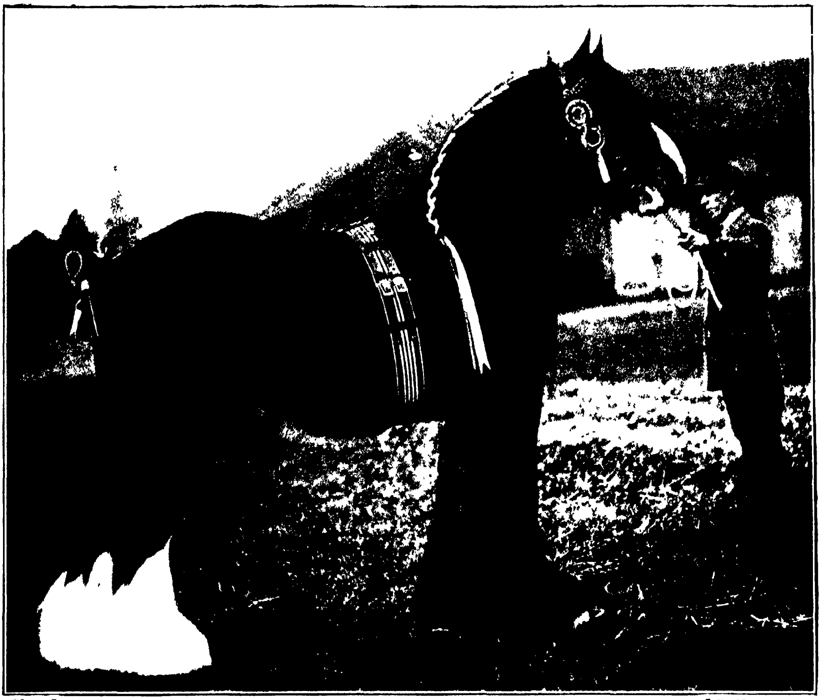

Photo.] [*G. H. Parsons.*

FIG. 1.—Shire Stallion, Field Marshal V.

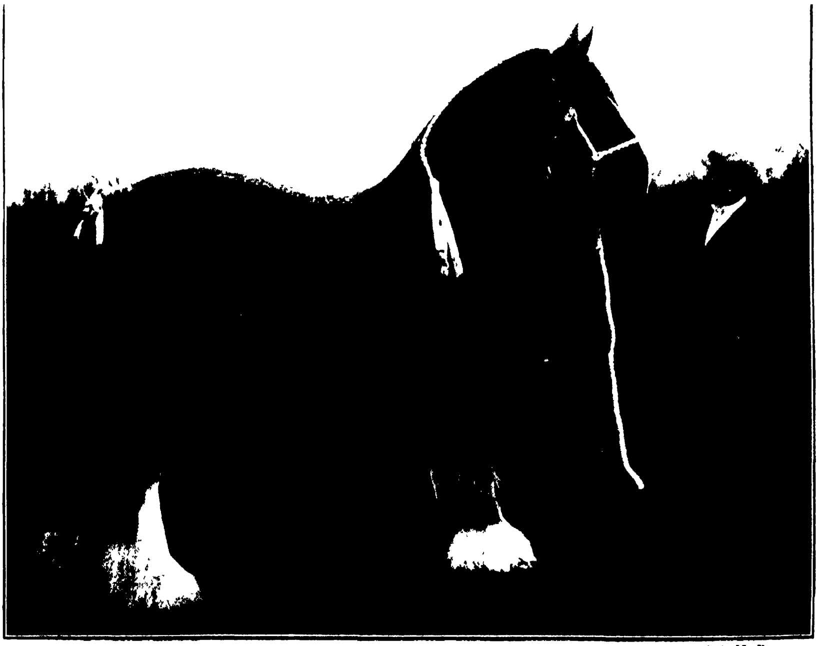

Photo.] [*G. H. Parsons.*

FIG. 2.—Shire Mare, Crossways Forest Maid.

The Shire has been especially fortunate in its supporters, King Edward was one of the first to recognise it and maintained a stud at Sandringham and those great mares Dunsmore Gloaming, Solace and Victor's Queen, all bred there, are probably unequalled for a trio of mares bred at one stud. King George has carried on the traditions and his famous Stallion Field Marshal V, twice winner of the coveted London Championship, is now proving himself equally successful at the stud. Staunch supporters were Lord Rothschild, Lord Middleton, the Duke of Devonshire, Lord Egerton, Lord Powis, the Duke of Westminster, Sir Walter Gilbey, Sir Albert Muntz, Sir Walpole Greenwell, Lord Wantage and Lord Redesdale, some of whom are still with us.

Other names are familiar to Shire Horse Breeders—the famous Forshaws, Mr. John Rowell, Mr. Alfred Clark (our late and present honoured Presidents), Messrs. Edward Green, F. W. Griffin, Jas. Gould, Shaw, Whinnerah, etc. These are known wherever Shire horse breeders congregate, but it would make a lengthy list to name all the men who have given and are giving their best to the furtherance of the interests of the breed. Sufficient has been written to show the place occupied by the breed in the heart of British farmers.

The Present.—Following years of unprecedented boom we have had an equally unprecedented slump. During and for a year after the late War Shires realised extraordinary prices—prices that could not be justified even if the trade of the country had continued good—then, as with everything else came the slump.

Everything was against the horse: industrial trade was bad, enormous quantities of Army horses and Army lorries were thrown on the market, and tractors were the latest novelty. Prices for horses fell all round, croakers said the heavy horse was doomed, and even amongst Shire horse breeders some were doubters, although the wise old hands and the tenant farmers, the backbone of the breed, stood firm and never lost faith in their breed. In the spring of this year the bottom was reached and since then a very slow but steady improvement has to be noted in the horse trade, which is reflected in the demand for Shires.

In addition to the bad times which have fallen to the lot of all horse breeders, the Shire has had to face strong, and in most cases healthy, competition. The Suffolks, a much improved breed with an active and enterprising Society which neglects no useful propaganda has made great strides during the last few years. The Clydesdale which is all-powerful in Scotland

produces some grand geldings. The Percheron is mainly in the hands of rich amateurs and at present has not gained much ground among the tenant farmers of England.

Attacks on the Shire and his work during the War were made in the press but soon died out. The supporters of the Shire do not suggest that every heavy horse with hair on his legs that went to France was of superlative merit, but they maintain that for the heaviest draught work, there was no other breed to equal the Shire, and a very large proportion of the horses in the heavy gun teams were Shires.

Further competition must be reckoned with, and as in war the best defensive is the offensive every effort should be made to push the interests of the Shire. For example, much good would be done at the Suffolk, Essex and Norfolk Shows by strengthening the classes for Shires so that a good representative collection of the breed should be seen at these shows. Above all, at the Royal, the battle ground of the breeds, the classes should be well filled and with the best examples of the breed available.

It is gratifying to observe that the ruling spirits in the Shire world are taking steps to bring before the public at home and abroad the merits of their breed as a heavy draught horse. Unfortunately owing to the state of trade no immediate result can be looked for abroad, but efforts at home should soon bear fruit. The Gelding Class at the Royal, which was assisted by the Shire Horse Society and which brought out probably the finest collection of Geldings that has ever been seen, was a notable gathering. The parade of these horses was one of the most effective features of the Royal and the eighteen grand specimens of the finished commercial article made a great impression on the crowds who attended the Show. The Gelding has been rather the "Cinderella" of the breed, and it is hoped that further efforts will be made on these lines, as there is no doubt that money spent on this object by the Shire Horse Society is spent wisely and well. The announcement has recently been made that the Shire Horse Society is presenting the Canadian Government with a stallion and five mares. This should do much for the breed. and result in an increased demand in that great Dominion.

The Future.—We are convinced that there is a great future in front of the Shire if breeding is carried out on the right lines. The question arises, as it does in every breed, "Is too much attention given to fancy over utility points?"

Feather is an essential part of the equipment of a Shire, but is too much attention paid to the profusion of hair that appears necessary to win to-day?

Is there rather a tendency to "early maturity" in the breed, and are not some of our colts and fillies better animals up to three years old than they are in later years? If so, which is doing the most for the breed, the wonderful foal or yearling, or the horse that does not come to his kingdom until he is four or five years old?

It is everywhere admitted that the Shire has enormously improved in legs, feet and soundness, but is sufficient attention being paid to those equally important needs, depth through the heart, back and constitution?

Lastly, is sufficient attention being paid to that most important point, stallion and mare "character," that quality which it is almost impossible to define but which every great breeder of any class of stock is most strongly influenced by?

It would be presumptuous on the part of any one person to give decided answers to all these questions, but it is clear that no harm and some good may be done by Shire Horse Breeders debating the points raised. In the writer's opinion, if it is borne in mind that the whole, sole and only object of the Shire Horse Breeder is the production of magnificent geldings like those seen at the Royal and at London and Provincial Horse Parades there will be no necessity to ask such questions.

There is every prospect of Shire horse breeding being a pleasant and profitable part of a farmer's business in the future as it was in the past. There are signs of an increasing demand for heavy horses. Motor lorries are expensive, both in first cost and in maintenance, and there is no question that with the reduced price of forage the horse is the cheaper motive power for short journeys with heavy loads. We do not want and shall not see the extravagant prices for horses that prevailed (it was the high price for horses and forage after the War that induced many merchants and team owners to try the motor lorry) but we expect to see a ready trade at reasonably remunerative prices in the near future for the finished article, the gelding, and this is bound to react favourably on the Shire horse breeder.

* * * * * *

CALIFORNIAN METHODS OF POULTRY RAISING AND MARKETING.*

I.

IT is a commonplace that the conditions under which many American industries have grown up have produced organisations different in many respects from those of Europe. The difference in conditions, however, has not been so great as to preclude the adoption in Europe of American methods, where these are found to be of value. Advantage has, in fact, so frequently been taken of American experience that it is the more remarkable that poultry-farming organisation in that country has hitherto been so little reflected in British methods.

That poultry-farming practice in the United States is worthy of investigation is shown by the following salient facts: that 22 million dozen eggs and 240 thousand dozen poultry were shipped in 1920 from a district in California some 50 square miles in extent; that a farm of 2,500 hens is considered to be one man's work; and that an annual net profit of $1.10 (normally 4s. 7d.) per hen is considered a somewhat low average.

It is true that the soil and climate of California are contributory causes of these arresting results, but they are by no means so important as is frequently held. The settlement which it is proposed to describe is only one of several in California, and the methods of all of them are common to most poultry-farming centres in America, even to those in the Eastern States, where the climate is less suitable than in England. Further, the methods and devices described below must not be regarded as the chief cause of prosperity: they are themselves the outcome of a business prosperity founded on three main principles—hard work, cleanliness, and attention to detail. There are no illusions in such communities regarding the exacting nature of the work necessary for success in poultry-farming, and unremitting attention is everywhere evident. The importance of cleanliness and adequate disinfection is also recognised. Dirt and disease are destructive of the results of so much labour that it has become an imperative business principle to avoid them. A continual application of these three principles has been a prime factor in creating the organisation which it is proposed shortly to outline.

* This report was drawn up by H.M. Acting Vice-Consul at San Francisco and was communicated through the Department of Overseas Trade.

This organisation has its centre at Petaluma, a town of some 6,000 inhabitants, situated near the northern extremity of San Francisco Bay. It is the headquarters of the small district which, as already stated, produced over 22 million dozen eggs in 1920, and although apparently the largest poultry raising community in the world, may be taken as typical of many similar centres throughout the United States.

Poultry Hatcheries.—The poultry-raiser of Petaluma usually obtains his stock from one of the "Hatcheries" of which there are several in the town. One of these, which may be taken as typical, hatched out one million chicks in 1921. The eggs are bought at about 10 cents above current prices by the hatchery, which is a business concern, and in no sense co-operative. The resultant chicks are sold at about three times the price of the original eggs. Eggs for hatching are bought from specially selected ranches known to the hatchery as possessors of highly productive strains; in some cases the hatcheries themselves supply cockerels, and are thus in very close touch with the pedigrees of the birds whose eggs they hatch. The incubators are arranged in tiers on racks in a large room and are heated by gas or electric appliances regulated by thermostats, of which there is one in each chamber. The air is kept comparatively moist by leaving the ground beneath the racks exposed, only the alleyways between being paved. This is scarcely sufficient for the upper ranges of incubators, and where necessary further moistening is provided by means of pans in the incubators. The eggs are turned by hand, the trays being grooved to make this task easy. The owners of the hatchery in question prefer this method to mechanical turning, as their experience shows that the mechanical method is productive of a considerable percentage of abnormal chicks. By the hand-turning method, combined, of course, with careful tending throughout the hatching period, an average hatch of 80 good chicks in every 100 is obtained.

When the newly-hatched chicks have been dried off they are placed in ventilated boxes containing 4 sections of 25 chicks each for delivery. Frequently, of course, local poultry farmers arrange to receive back the chicks hatched from eggs supplied by themselves, but large numbers of day-old chicks are sent considerable distances to the hatchery's customers. It is found possible to send day-old chicks on a 72-hour journey without injury or prejudice to their subsequent growth.

An interesting feature of the organisation of the hatchery under notice is that one of the partners, who is a qualified

veterinarian, is placed at the disposal of all purchasers of day-old chicks who live within a reasonable distance. If any trouble arises or if any advice is needed his services are invoked. This procedure is of great value to the hatchery both for purposes of advertisement, and because it ensures a larger percentage of survivals than would otherwise be the case. The veterinarian further justifies his existence by superintending a model poultry farm owned by the hatchery.

Brooding.—A great deal of attention is naturally given to the brooding of young chicks, and numerous types of houses and machines are in use. One of the favourite methods is by the use of what is known as the "Kresky" house. This consists of two rooms, one of which is kept heated at 75° F. by means of an oil stove and thermostat, the second being considerably cooler. A small entrance is provided from the warm to the cool room, and from the latter to the chicken-run, so that the chicks may accustom themselves to the different temperatures. The room floors are usually covered with some form of warm, dry litter, and the corners are rounded off to prevent suffocation of chicks by crowding into corners.

Trays of grit are placed in both rooms, and frequently a continuous water supply and food supply is provided.

This form of house appears very useful for large numbers of chicks. The owner of a "ranch" in Petaluma recently raised 6,000 chicks in four Kresky houses each room of which could not have been more than 20 ft. by 16 ft. Including the open-air "run," these 6,000 chicks were raised in an area of less than half an acre; and although their owner, having neglected to separate his cockerels at the earliest possible moment, was, in this case, risking loss by overcrowding, there is no doubt that chicks are brooded successfully in very confined areas. One square foot for young chicks and two square feet for hens and pullets is the room considered desirable here.

Various forms of smaller artificial brooders are in use. The majority of these are heated by oil or coal stoves. This method has the advantage of needing only one house, instead of two, as with the Kresky method. An electric brooder of orthodox design was also seen, the heat being supplied by wire coils beneath the floor of the brooder. In all cases regulation is provided by a thermostat which, in the case of the electric brooder, showed a small light when current was being used.

The size of the flocks of young chicks placed in the brooders is a feature of Petaluma. The batches vary from 500 to 6,000,

2,000 being a frequent quantity. The cockerels are separated at the earliest possible moment. Success is only due to detailed personal attention to such matters as feeding, ventilation, control of light, and care that the chickens do not damage each other by toe-picking, overcrowding and so on.

Houses.—The Chamber of Commerce of Petaluma encourages the use of trap-nests and modern hen-houses by means of egg-laying contests and kindred activities, while, as will be shown later, the methods of the co-operative egg-marketing association make it to the interest of the poultry farmer to use the most scientific methods possible. Many of the Petaluma ranches still retain the "Colony" type of hen-house with a common run for several houses, but these are being supplanted, whenever possible, by more modern types of houses. The scheme now being adopted is to provide a house accommodating some 3,000 hens, the house being divided into sections each holding about 250 birds. A separate run is provided for each section, and where possible, a double run system is used, the runs either being arranged on both sides of the house or divided longitudinally on one side only.

Trap-nest systems appear generally to be confined to ranches producing eggs for hatching, and the majority of the farmers rely on their experience in judging the qualities of a hen, combined with the system known as "Hoganising" (*i.e.* the handling test).

The houses of the poultry-farm owned by the hatchery described below may be taken as typical of the principle upon which Petaluma farmers work, though in practice possibly not many of the ranches are so scientifically organised throughout.

The houses on this ranch, some 50 ft. long by 20 ft. wide, are built to accommodate 500 hens. They are lighted by muslin-covered windows and by electric light. The roosting perches run lengthways, are movable, and on one level. They are wide enough for the hen to perch without grasping with the feet, as this form of perch is considered to be less tiring for the hen, and hence to contribute something towards its egg-laying capacity. Beneath the roost is a dropping board, some 3 ft. 6 in. from the ground and 12 in. below the perches. These arrangements leave the whole of one side and one end of the house for trap-nests, which are placed at a height of about 4 ft. from the ground, to make egg-collecting easy.

One trap-nest for every three hens is found to be sufficient, eggs being collected every hour, and credited to the

record of the hen. A bucket is suspended by a wire moving in front of the nests, so that no stooping or unnecessary labour is entailed. In so exacting a business as poultry-farming on this scale, such labour-saving devices are invaluable. Clean dry litter is kept on the floor and covered-in, water-troughs are provided at a height of 18 in. to 2 ft. from the ground to prevent litter being scraped into the water. Feed mixtures are placed in a dry-mash hopper. It appears that the advocates of dry and wet mashes are fairly equally divided, though probably slightly more dry mash is fed on account of the saving in labour as compared with the wet mash, a dry hopper needing to be filled only once or twice per week. Where wet mashes are used they are mixed with green food to avoid wastage. Many successful farmers pay great attention to the supply of green food, care being taken to provide different varieties.

The problem of the fouling of land in Petaluma Valley is a comparatively easy one. The soil is almost everywhere a light, sandy loam, porous, and productive; the climate is mild and equable; and, the district being well provided with small hills, natural drainage is almost universal. Under these conditions the double-yard system can be used to the greatest advantage. A foul yard is ploughed up, limed. rested for a few days, and then sown with quick-sprouting seed. At the end of three weeks there is usually a growth some 6 or 7 in. high, and the hens can be turned on to this. It is thus possible to confine the birds to an area which they will completely foul in three or four weeks, and by carrying out the process described above, to keep a large flock of poultry on a very small tract of ground.

The Feeding Problem.—The dimensions of the poultry-farming industry here have resulted in simplifying the feeding problem also. There are several grain merchants established in the town who import their grain from the neighbouring Sacramento and San Joaquin Valleys by cheap water transport. They mix their feeds in Petaluma itself and by establishing carefully composed brands of uniformly good quality, have materially reduced the poultry-farmers' cares while ensuring a constant market for their goods. Most of the grain and meal seen in the repositories was of good quality and remarkably clean. It is a noteworthy result of the magnitude and intensiveness of the Californian agricultural industries—in fruit growing and dairying as well as in poultry-farming—that great importance is attached to the grading and branding of the

various products. The producers themselves are so well aware of the commercial value of a good reputation for their goods that they go to considerable trouble to keep their brand uniform in quality, and are the more ready to place confidence in the branded grades of producers of other articles.

The buyer of poultry foods in Petaluma is, therefore, almost always willing to trust to a known mixture and rarely finds his trust misplaced. He is able, in consequence, to free himself from the necessity of growing or mixing grain himself.

Culling.—Another point upon which stress is laid is the elimination of the unfit or "culling." Unfit or unpromising chicks and bad layers are weeded out constantly on the principle that food is lost if given to an unworthy bird. The average bird is expected to lay 120 eggs in a year, and if she falls below this standard by the trap-nest or other record, she is sacrificed without compunction.

Co-operative Sale of Eggs.—It is after the collection of the eggs that the poultry-farmer comes within the sphere of influence of the co-operative society known as the Poultry Producers of Central California Incorporated. Some 75 per cent. of the Petaluma farmers belong to this organisation, which concerns itself with the marketing of the eggs. The farmer is expected to clean the eggs if necessary with a wad of steel wool (this having been found to be by far the most effective and least injurious method) and to grade them according to their size, colour and degrees of dirtiness. He buys egg-boxes holding 30 dozen from the co-operative society, and delivers them himself, when packed, at the society's depôt. The society's organisation makes it capable of obtaining the best and most stable price possible for eggs, the receipts being credited to the farmer according to the quantity of eggs which he has delivered.

(*To be concluded.*)

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FARM INSTITUTES.

PART II.

IN the August issue of this *Journal* (pp. 400-408) a summary was given of the training provided at four of the Farm Institutes which have been established in this country. A further four Institutes are described briefly below. One of these—the Chadacre Agricultural Institute—has been provided entirely through the generosity of the Earl of Iveagh, and is unique inasmuch as board and tuition are entirely free of cost to male students.

THE SOMERSET FARM INSTITUTE, CANNINGTON, Near BRIDGWATER.—Cannington Court, four miles from Bridgwater, is a large mansion held on lease by the Somerset County Council, who have had the premises adapted, furnished and equipped as a Farm Institute on the most modern lines. The history of Cannington Court is interesting and can be traced back to the middle of the 12th Century when it was occupied by nuns, living under the Rule of St. Benedict, who continued to follow their peaceful avocation within its precincts until the dissolution of the monasteries some 400 years later. Subsequently it became the residence of a noble family, then was used once again as a nunnery, and more recently has been an industrial school for Roman Catholic boys. Fragments only of the original buildings remain, however, the present buildings being partly 15th Century and mainly Elizabethan. Central heating and electric light have been installed, and the interior of the building, with its common rooms, class rooms and numerous bedrooms, has been completely transformed. When the extensions now in progress are completed, the hostel will accommodate 25 women and 25 men. The Institute should attract students from neighbouring counties as it is the only one of its kind in the south-west of England.

The Farm.—The farm, adjoining the Institute, covers 175 acres, about 80 acres being arable land—a medium loam, well adapted for cultivation and general demonstration—92 acres pasture and meadow land typical of the heavy alluvial soils adjoining the River Parrett, and 3 acres a grass orchard. The live stock include 7 working horses, 21 dairy Shorthorn cows, 71 ewes, which produced some excellent forward lambs this year, and 72 pigs—Gloucester Old Spots, Large Blacks and Wessex

Saddlebacks. The farm buildings, remodelled to secure economy in the housing and feeding of live stock and in the preservation of farmyard manure, have gravitation water laid on and electric light installed, and the dairy, fully equipped with modern appliances for the treatment of milk and the making of butter and cheese, is remarkable for its cleanliness, good order and business-like management

The Agricultural Course.—The agricultural course consists of three terms of 12 weeks each, thus covering a full year's farming operations. Whenever possible the lectures are given on the farm instead of in the lecture room and the students take part in all kinds of farm work, including dairying and horticulture. Mr. James Mackie, M.A., B.Sc. (Agr.), is Principal of the Institute and Agricultural Organiser for Somerset.

During the first term of the agricultural course, the student is instructed in the nature of soils, their adaptability, improvement, etc.; the use of the various kinds of farm implements and machinery; the rotation of crops, their harvesting and marketing; general science, including the structure and growth of plants; land surveying; and some aspects of horticulture. In the second term he will also study the use of manures, feeding-stuffs, plant nutrition, seed testing, the identification of plants and weeds and the first principles of book-keeping and farm accounts; and in the third will devote attention to the feeding, breeding and general management of live stock; veterinary science and the control of animal disease; the treatment of fungoid diseases; insect pests, and the cultivation of certain fruit and vegetable crops. The practical application of the teaching given during this course is emphasised and the whole of the instruction given is so designed as to be of immediate utility and application. It is meant primarily for the sons and daughters of farmers and those who propose to become farmers or farm managers.

The horticultural course consists of three terms of 12 weeks. Students take part, under the supervision of the horticultural staff, in all classes of work in the gardens and orchards, which are well stocked with tree and bush fruit. The aim of this course is to give a practical training in growing fruit and market garden crops for sale. The pupils will also receive instruction in bee-keeping, including practical apiary work, and will attend the classes in general science, land surveying and book-keeping, which will be supplemented by special lectures adapting this instruction to horticultural practice.

Dairying and Poultry Keeping.—The full course in dairying and poultry keeping lasts for 12 weeks. In addition to attending lectures and demonstrations, the pupils take part in practical work in milking, the handling of milk, and the making of butter and cheese. When the poultry section is more fully equipped, they will practise the fattening, killing and dressing of poultry for table and market. Domestic science is included in the women's course. An exhibition of the work of the several departments was arranged at the County Show at Bridgwater last May. No pains are being spared to make the Institute a success in its educational and—hardly less important in a school of this kind—its social aspect. The students are fortunate enough to enjoy the use of an open-air swimming bath, a tennis court and games equipment provided by the County Council.

Scholarships.—Two Farm Institute Scholarships in agriculture and one in horticulture are offered for competition annually, the holders being entitled to free tuition, board and residence for one year; two free Studentships in dairying are also offered each term. Two Senior Agricultural Scholarships tenable for two years at University College, Reading, or some other approved institution, may be competed for by students who have attended the Farm Institute course and intend to follow an agricultural calling.

CHADACRE AGRICULTURAL INSTITUTE, SUFFOLK.—This Institute is the gift of the Earl of Iveagh, who purchased the estate in 1920 for the purpose of founding and endowing an Institute at which the sons of agricultural workers, small holders, small farmers, etc., should be given instruction in the practical and scientific principles of agriculture. For students coming within the above description, training, board and lodging are free. In the summer months instruction is given to women in dairying, poultry keeping and horticulture; this is also free, but a charge is made for board.

Chadacre Hall will accommodate about 40 male students. It comprises large dining and recreation rooms, two lecture rooms, a chemical laboratory, and dormitories, and is fitted throughout with electric light.

The Farm.—The farm is 500 acres in extent, including a park of 100 acres containing fine specimens of shrubs and various trees, which is surrounded by plantations covering another 100 acres. Good opportunities are thus afforded for teaching forestry and woodman's work, and students are instructed in farm car-

FIG. 1.—Farm Institute, Chadacre: South-west View.

FIG. 2.—Farm Institute, Chadacre: Home Farm and Dairy.

pentry and joinery in the carpenter's shop, where the timber grown on the estate is utilized. 336 acres are under arable cultivation; the extensive gardens are laid out for market gardening, fruit growing, horticulture and bee-keeping. There are, in fact, four farms which are now being run as one. The soil is a heavy clay mixed with a small amount of chalk and flints. Much of the land is in poor condition, especially the pastures, but already where slag has been applied the beneficial effect on the wild white clover is very marked. The arable land has apparently been ploughed at a shallow depth for many years, and it is intended that a certain proportion of the land each year shall be steam cultivated or sub-soiled when ploughed in order to break up the pan. Up to the present 70 acres have been so treated. Most of the fields, moreover, are wet, and part of the land will be mole-drained each year: 60 acres have already been done. Green manuring and forage cropping are practised. The students will learn many useful lessons from the various measures which are being taken to improve the condition of the farm.

Courses of Instruction.—The aim of all courses of teaching and training at the Institute is instruction in farming as a business and in farming operations as a means of livelihood with a view to turning out skilled and intelligent workers. The estate and lands are worked, farmed and run, on practical lines for profit, with a full staff of workers, and the employment of pupils in the Institute is directed to giving them not only a practical acquaintance with the ordinary operations connected with a farm or garden, but also instruction in the underlying scientific principles. The teaching given at the Institute extends to carpentry, saddlery, implement repairing, basket making, etc.

The Winter Course for male students consists of two winter sessions of about six months each, commencing at Michaelmas and ending at Lady Day. Students are therefore able to return to their homes at a busy time of the year and to work on the land until the end of the harvest. Such a method benefits the small farmer by giving him the services of the pupil when these are most needed, besides keeping the pupil in touch with his home surroundings and giving him the opportunity to put into practice knowledge acquired at the Institute.

Farm classes are a special feature of the instruction and include a practical demonstration of every matter dealt with in the class room, *e.g.*, ploughing, sowing, marketing, hedging, ditching, thatching, the use of different kinds of machinery, stock judging, buying and selling stock, the estimation of the value

of corn, straw and hay in stacks, and roots in clamps. Occasional visits are made to Bury St. Edmunds Auction Mart for the study of live stock, and to farms having special features of interest.

The course of instruction includes agriculture; agricultural science; land measuring and mensuration; farm accounts; veterinary hygiene; farm implements and machinery; joinery and carpentry work; smith's work; horse shoeing; dairying, including production of *clean* milk; poultry keeping, beekeeping, etc. Practical instruction is given in horticulture, marketing, butter making and milk testing, as well as demonstrations in cheese making, poultry trussing, etc. In the more advanced stages, the practical work includes feeding stock and compounding rations, and examining and identifying food stuffs, artificial manures, grass, clover, cereals and their seeds.

Two summer courses for female students in dairy work and poultry keeping are held, commencing in April and June respectively and lasting for nine weeks. Practical instruction is given in milking, separating, milk testing, butter making, and the making of hard cheese and cream cheese. Lectures and practical instruction in poultry keeping are also given, the course being specially suitable for farmers' daughters and others who propose to take up this branch of work.

THE HAMPSHIRE COUNTY COUNCIL FARM INSTITUTE.—From 1900 to 1914 the Hampshire County Council Farm School was established at Old Basing, near Basingstoke, but towards the end of this period, owing to the increasing demand for agricultural education it was removed to its present position at Sparsholt. The Institute is situated on high ground four miles north-west of Winchester, and is therefore central, both for the County, and for the Headquarters of the County Council. The Principal is Mr. L. G. Troup, B.Sc. (Agric.). Thirty residential students can be accommodated. Between 50 and 60 students have attended the Farm Institute annually during the past few years.

The Farm consists of 250 acres of land overlying chalk, and is typical of much of the land in Hampshire; roughly half of the land is arable. A herd of about 30 dairy Shorthorn cows is maintained by the rearing of young stock, and is being graded up by the use of good bulls. Clean milk production is practised, and the tuberculin test has been carried out. A

number of steers are reared and fattened off at from 16 to 21 months old. A small breeding flock of pedigree Ryeland sheep is kept, and additional sheep are bought as required. The nucleus of a herd of Large Black pigs has recently been obtained, and there is a considerable number of cross-bred pigs on the farm. Field work is carried out both by horses and tractor.

Additions made to the farm buildings during the past year include a dutch barn, an implement shed for demonstration purposes, stock boxes, a large covered yard, and a new food preparing machinery and administrative block.

The Gardens extend to 5½ acres, and were laid out in 1914 for ordinary hard and soft fruit and vegetable culture. A greenhouse is also available. The Dairy is equipped with apparatus for steam sterilization in addition to that for making hard and soft cheeses and butter. The Poultry Department has been greatly improved recently, and provides facilities for complete instruction in the various branches of this subject. Four utility strains of different breeds are kept, and ducks have recently been added. The Bee department consists of about 25 stocks. In addition to providing instruction in this subject to students, the department distributes a considerable number of nucleus stocks to bee-keepers in the County during the season.

Courses of Instruction.—The work of the Farm Institute is largely practical, only sufficient lectures being given to give students a basis of knowledge on which to work. Instruction is given in agriculture, horticulture, dairying, poultry-keeping, farriery, farm engineering, book-keeping, veterinary hygiene, carpentry, etc. The session is divided into 3 terms, viz., autumn and spring terms of 12 weeks each, and a summer term of 15 weeks.

All students taking general agriculture and allied subjects are recommended to take the one-year course, which commences in October. In this way the operations extending over a complete year can be followed. A six-months' winter course is provided for farmers' sons who can only be spared from home during the winter.

A one-year course for the British Dairy Farmers' Association examinations in butter and cheesemaking is recommended to students who intend to take dairying posts, and is also recognised as an approved preliminary course for the National Diploma in Dairying.

Special courses can be arranged in one or more subjects if desired. Short courses in dairying, horticulture, bee-keeping, and poultry-keeping are arranged during the summer.

Experimental Work.—A considerable amount of experimental work is carried on both on the farm and in the county, and the results are published annually. The importance of such work to students cannot be too strongly emphasised, as owing to their assisting with the experiments, the faculties of careful observation and thought are strongly developed. Visits to farms in the neighbourhood are arranged when possible, and lectures by specialists in agriculture are given at the Farm Institute during the winter.

Scholarships.—Six scholarships for the winter course are awarded annually to boys over 15 years of age, entitling the holders to free instruction, board and residence for 24 weeks. Preference is given to the sons of Hampshire farmers, dairymen or others connected with the land.

Young men and women who have attended a course of lectures in horticulture in the county are eligible to compete for three scholarships for a six months' course in practical horticulture.

Twelve scholarships for a five-weeks' course in dairying are also offered. An examination is held at the close of the winter course to decide the award of two scholarships tenable at the University College, Reading, for a six-months' course. Certificates are also awarded as a result of this examination, to students reaching the required standard.

MOULTON FARM INSTITUTE, Near NORTHAMPTON.—The village of Moulton, on the outskirts of which the Farm Institute stands, is situated in the centre of the county, 5 miles from Northampton. At Michaelmas, 1915, the Northamptonshire County Council became the tenants of Moulton Grounds Farm; since 1920 they have been the owners of the freehold, formerly vested in the Wantage Trustees. A property adjoining the farm, consisting of two detached houses, four cottages, gardens and some grass paddocks, was acquired in July, 1919, by the Council, who have erected in the grounds, with a commendable economy in expenditure, laboratory, teaching and sleeping accommodation. All the residential places at the Institute available, which can take 16 male students at one time, were filled for the main winter course, and, in addition, 4 students attended for instruction only. The Agricultural Organiser, Mr. W. A. Stewart, M.A., B.Sc. (Agr.), who is also

Principal of the Farm Institute, lives in one of the houses; the other, "Southolme," which has lately been enlarged, is occupied by the domestic staff and contains, besides rooms for the warden, matron and teaching staff, the students' dining room, common room and recreation room. There is a playing field on the farm and games are encouraged.

The Farm.—The farm is 168 acres in area, the soil for the most part varying from light loam to heavy clay, one-third being typical Northampton sand; the land is clean and hedges and boundaries are well looked after. Of the 110 acres of arable land rather more than half is under corn. Trials are carried out with different varieties of cereals and roots, and experiments are conducted in the manuring of crops and the feeding of stock. During the years 1919-20 and 1920-21 the farm was run at a profit—an unusual feature among institute farms at that period.

A special feature is made of live stock on the principle of building up from small beginnings. The cattle are dual-purpose Shorthorns, mostly of Cumberland and Westmorland breeding. Calves are reared and milk records are kept. A few of the cattle are pedigree and it is proposed to grade-up and ultimately to register in the Shorthorn Herd Book. The Principal has been able to acquire an exceptionally fine lot of cattle. He is in close touch with the breeders of pedigree stock of all kinds, of whom there are many in the county, and who are always willing to allow the students to inspect their herds. The pigs are registered Large Blacks, kept on a modified open-air system mainly on the arable land. Draft auction sales, an innovation that might well be extended to other Farm Institutes, were held on the farm in 1920 and 1921 and helped materially to bring the work of the Institute to the notice of the farming public who attended in large numbers.

The light land is particularly suitable for the folding of sheep and a flock is maintained during the winter, chiefly on arable land crops.

The horses are of Shire blood: breeding is engaged in as circumstances permit. A flock of poultry (White Wyandottes) is kept.

The Courses of Instruction.—The primary object of the educational work is to provide instruction in the principles underlying the practice of agriculture, with special reference to the manuring of crops and the feeding of stock, to the study of farm book-keeping and the application of business principles

to agriculture. A winter course of instruction is held from October to March. The students are able to observe the results of various experiments and demonstrations on the farm, whilst in the laboratories practical work is carried out in soil analysis, seed-testing, etc.

There is a fruit plantation and market garden having an area of 2 acres. Here market garden crops are grown between fruit trees on the Evesham system, which enables the grower to employ horse-drawn or motor-drawn implements, and ensures a return even when fruit crops fail. Practical work in horticulture also includes propagation by cuttings, layers, grafters and budding. Inasmuch as the produce of the plot is graded and packed and disposed of commercially, students have the opportunity of observing every process from the preparation of the land to the marketing of the crop.

A summer course in dairy farming and poultry-keeping—attended this year by 12 women—is also held; other short courses are arranged as and when occasion demands. Pupils are taken at the farm in preparation for the winter course and at other times during the year.

The Committee are prepared to consider the admission at reduced fees or without charge of a limited number of students who are competent to benefit by a course of instruction at the Institute but whose circumstances are such that they cannot pay the full fee.

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FIELD EXPERIMENTS WITH ROCK PHOSPHATES AND BASIC SLAGS.*

I.

G. S. ROBERTSON, D.Sc., F.I.C.

SOME ten or twelve years ago the Basic Open Hearth Process of manufacturing steel was introduced, and as it had the advantages of being more economical than the Basic Bessemer Process and of permitting the more extensive use of our lower grade ores, it has now almost replaced the older process.

Basic Slag.—The slag which results from the new process is still, to the steel manufacturers, a "basic slag," but it is no longer the "basic slag" with which the farmer has become so familiar and to which he attached so high a value. It contains a much smaller percentage of phosphate, the phosphates are of a different type, and in many instances they are far less soluble than those of the old Basic Bessemer Slag.

For practical purposes basic slags now obtainable may be divided into three types:—

Type (1) *High Grade*, containing from 33 to 42 per cent. of phosphate. A part of this supply consists of the rapidly diminishing remnants of the Basic Bessemer Slag, and agriculturists must face the probability of the complete disappearance of this class of slag.

Type (2) *Open Hearth Basic Slag*, containing from 15 to 32 per cent. of phosphate.

Type (3) *Open Hearth Fluorspar Slag*, containing from 15 to 32 per cent. of phosphate.

Types 1 and 2 have a citric solubility of from 80 to 95 per cent. and may be safely taken to be of equal value per unit of phosphate.

Type 3 has a citric solubility of from 6 to 50 per cent., and it is this type of slag which is of uncertain value. It is impossible to distinguish Open Hearth Fluorspar Slag from the other types by appearance, and if a purchaser wishes to avoid buying basic slag of this type it is only possible to do so by obtaining a solubility guarantee.

How much of the present supply is of the Open Hearth Fluorspar type it is not possible to say, but it is certain that the proportion is likely to increase in the future, and as it is

* This Article is based on a monograph on "Basic Slags and Rock Phosphates by Dr. Robertson, recently published by the Cambridge University Press. The Ministry is indebted to the Syndics of the Cambridge University Press for permission to utilise Tables 2, 3 and 4 and Figs. 1 to 5.

only a by-product there is no likelihood of it ever being worth the steel maker's while to modify his processes in order to produce a basic slag similar to that which has been in use in the past.*

Mineral or Rock Phosphates.—One of the possible substitutes for the old type of basic slag is ground mineral phosphate. Like basic slag, rock phosphates are basic in character; they have the advantage of a very high content of phosphate—from 50-88 per cent., depending upon the source. On the other hand they are considerably less soluble in citric acid than the high-grade basic slags, but are better in this respect than the new open hearth fluorspar slags. Experts differ as to the extent to which citric solubility may be taken as a measure of the relative value of such types of phosphates, and the matter can only be settled by extensive field trials.

It is important to remember that the various rock phosphates are not identical in character—they differ not only in their source but in chemical composition and in solubility in citric acid. In the following table the various rock phosphates are set out in the order of their solubility and their origin; their approximate content of phosphate is also indicated :—

TABLE I.

Name of Phosphate.	*Origin.*	*Approximate content of Phosphate.* per cent.	*Citric Solubility.* per cent.
Gafsa	North Africa ...	56—64 ...	38
Egyptian	„ „ ...	56—60	35
Algerian	„ „ ...	58—66 ...	33
Florida Soft	United States ...	48—54 ...	27
Tunisian	North Africa ...	54—60 ...	24
Tennessee	United States ...	30—60 ...	23
Nauru	Oceania	82—88 ...	21
Makatea	Oceania	82—86 ...	19
Florida Pebble ...	United States ...	70—76 ...	18

In general, the higher the percentage of phosphates in these natural phosphates the lower is their citric solubility. In this respect there is a great difference between Gafsa phosphate at the head of the table and Makatea and Florida Pebble at the bottom. It is, therefore, necessary to take such facts into consideration when planning field experiments, as it may well

* A Committee has been appointed by the Minister of Agriculture to study the problem thus created. Two reports of the Committee have been issued, the first of which was summarised in this *Journal* for September, 1921, and the second of which follows this article at p. 530. These reports contain among other information a summary of the results of field trials with slags now obtainable.

prove as important to distinguish between the extreme types of rock phosphates as between those of basic slag.

The Essex Experiments.—It was with the above considerations in view that the Essex Experiments were designed and laid down in the period 1915-19. As far as possible the various types of basic slag likely to be produced in the future were included in the field trials, and also a number of rock phosphates. Meadow land was chosen for the experiments because such land in Essex does not as a rule receive artificial manures. The soil was known to be poor in phosphoric acid, and a good response to phosphates could, therefore, be anticipated. Moreover, it is on grass land, whether hay or pasture, that the direct and indirect response to phosphates is most clear. The plots were one-quarter of an acre in area. Three types of basic slag have been used—Basic Bessemer, Basic Open Hearth Slag and Basic Open Hearth Fluorspar Slag—and these have been compared with the following rock phosphates:—Florida Pebble, Tunisian, Algerian, Gafsa, and Egyptian, and Cambridge Coprolites. At some of the centres plots dressed with superphosphate, with superphosphate and lime, and with lime alone have been included. The phosphates were applied during the period December to February. Unless specifically mentioned the initial dressings of the various phosphates contained 200 lb. of phosphoric acid per acre (approximately equal to 10 cwt. per acre of a 38-40 per cent. basic slag). No further dressing of phosphates was applied at any time during the course of the experiment and no other artificials have been applied to the plots. The hay crop was cut and weighed at each centre over a period of years, the whole of the crop being weighed on each plot immediately before stacking.

Eight experimental centres were laid down, the following soil formations being represented: London Clay, Boulder Clay and Chalk. The results from three of these centres are given below as they suffice to show the chief results obtained and the main conclusions drawn from the experiments.

Martins Hearne Farm: Boulder Clay Soil.—The experimental field at this farm had been down in grass for at least eighty years before the experiment began. During that period no artificial manures had been applied, but the meadow had received during the last twenty years at intervals of seven to eight years a dressing of about ten loads of farmyard manure per acre. The herbage was of the poorest character. The results

for the five years 1917 to 1921 are shown in Table 2 and are illustrated in Fig. 1:—

TABLE 2.—WEIGHT OF HAY AT MARTINS HEARNE FARM.
Manures sown: 20th February, 1917.

Plots ¼ acre	MANURE 200 lb. P_2O_5 per acre	Citric solubility of phosphate, per cent.	HAY (in cwt. per acre).					
			1917	1918	1919	1920	1921	Average 5 years
1	Open hearth (fluorspar) basic slag	20·1	23·0	28·6	16·4	28·4	9·9	21·3
2	Open hearth basic slag...	91·2	30·4	33·4	27·0	31·9	13·4	27·2
3	No manure	—	14·3	23·4	10·4	23·0	9·4	16·1
4	Gafsa rock phosphate ...	38·6	23·8	38·6	24·8	35·2	15·6	27·6
5	Egyptian rock phosphate	35·0	22·8	35·9	21·9	29·0	10·8	24·1
6	Algerian ,, ,,	35·7	23·2	35·0	21·0	34·6	12·7	25·3
7	Farmyard manure* ...	—	—	—	—	40·3	15·5	—
	Rainfall, May 1st till harvest (in inches)...	—	6·27	11·51	2·85	8·37	2·44	
	Plots cut	—	July 23	Aug. 10	July 9	Aug. 9		

* Applied at the rate of 10 loads per acre in the autumn of 1919.

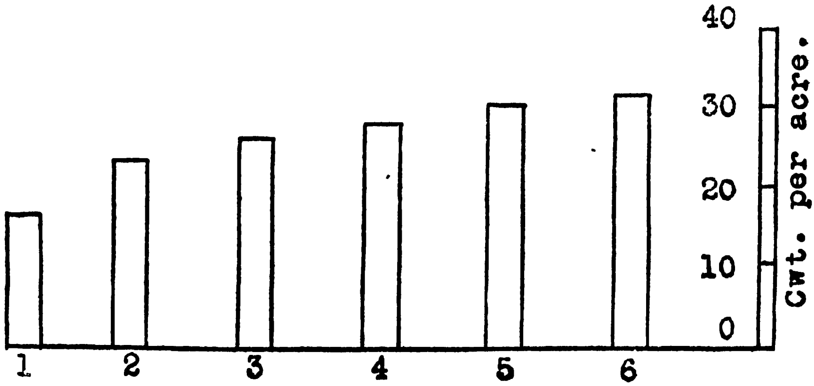

FIG. 1.—Yield of Hay (average of 4 years) from the various Phosphate Plots at Martins Hearne. 1, Untreated. 2, Open Hearth (fluorspar) basic slag. 3, Egyptian phosphate. 4, Algerian phosphate. 5, Gafsa phosphate. 6, Open Hearth (high sol.) basic slag.

The improvement which followed the application of the various phosphates was very marked indeed. During 1917 a mat of wild white and red clover began to cover the plots, and during 1918 it was so thick on some plots as almost to exclude the grasses.

As will be seen from Table 2 the high soluble slag proved considerably more effective than the open hearth fluorspar slag (low soluble) throughout the whole course of the experiment.

FIG. 2. Martins Hearne, 3rd June, 1918. Plot 3, untreated.

FIG. 3.—Martins Hearne, 3rd June, 1918. Plot 4, treated with Gafsa Phosphate.

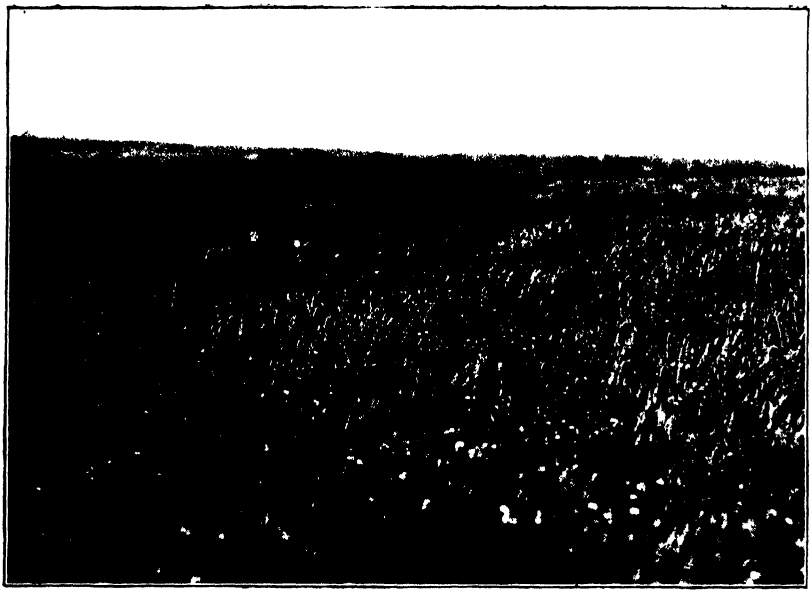

FIG. 4.—Horndon-on-the-Hill, July, 1920. Plot K. untreated.

FIG. 5.—Horndon-on-the-Hill, July, 1920. Plot H treated with Cleveland Phosphate.

On the average of 5 years the Gafsa phosphate has proved just as effective as the high soluble slag, and, although not quite so good, Algerian and Egyptian phosphates follow closely behind.

During the season of 1919 clover did not make its appearance on any of the plots. The rock phosphate and basic slag plots could, however, be clearly distinguished from the untreated, even at a distance, by their healthier green colour. In 1920 clover was present in the hay crop on the basic slag and rock phosphate plots to the extent of from 27-35 per cent. of the crop by weight.

Horndon-on-the-Hill: London Clay.—The soil is a heavy London Clay containing a small reserve of calcium carbonate (0.25 per cent.)—the residuum of the heavy dressings of past times. The soil is exceedingly heavy and impervious and is known in Essex as "three horse land." It is always put up into 7 ft. 6 in. stetches, to secure the maximum amount of drainage. The experimental field, like all fields whether grass or arable on this type of soil, lies cold and wet during the autumn in spite of the fact that the annual rainfall is only 20 in.—the lowest in the country. The summer is equally trying—the dry and hot weather which is usually experienced in Essex in June and the latter part of May "caps" or bakes the soil. It is but seldom that the crop of hay exceeds 10 cwt. to the acre and it is only too frequently left uncut altogether.

The experimental field was laid down to grass in 1890, and until the experiments started had received no manurial treatment of any description.

In this experiment an attempt was made to ascertain whether better effects could be obtained from rock phosphates by finer grinding. With this object in view the Florida Pebble, Algerian, Gafsa, and Tunisian phosphates used were specially ground

All the phosphates were passed through a Griffin Mill for "coarse grinding," the mill being adjusted to give the standard usual for the manufacture of superphosphate (90 per cent. to pass a 60 sieve). In actual fact about 80 per cent. of the material will pass a "100" sieve, *i.e.*, a sieve with 10,000 holes to the square inch. For fine grinding the mill was closed down so that the output per hour was reduced by one-half. A much finer product was obtained, but owing to the "woolly" nature of the rock phosphates it has not been practicable to distinguish satisfactorily by means of sieves between the "fine" and the "coarse" grinding.

The results are set out in Table 8 :—

TABLE 8.—WEIGHT OF HAY AT GREAT MULGRAVES, HORNDON-ON-THE-HILL.

[Dressing 200 lb. P_2O_5 per acre unless otherwise stated.

Plots	MANURE	Citric solubility of the phosphate, per cent.	HAY (in cwt. per acre).		
			1918 *	1919	1920
A	No manure	—	—		4·5
B	Cambridge coprolites	25·0	—		15·9
C	Lime at rate of 1 ton per acre ...	—	—		5·0
D	Rough slag (double dressing) ...	—	—		17·2
1	Florida pebble phosphate (fine) ...	19·2	14·2	Plots grazed by cattle and sheep.	17·0
2	,, ,, ,, (coarse)	18·2	13·7		14·7
3	Algerian phosphate (fine) ...	35·7	14·7		21·5
4	,, ,, (coarse) ...	33·4	14·9		19·7
5	Open hearth basic slag : high sol.	91·2	18·8		23·2
6	No manure	—	11·1		6·4
7	Gafsa rock phosphate (coarse) ...	38·6	17·8		22·3
8	,, ,, ,, ,, ...	38·6	18·4		22·2
9	Tunisian ,, (fine) ...	26·0	17·9		23·2
10	,, ,, (coarse) ...	23·9	19·2		23·8
11	Egyptian ,, (fine) ...	37·0	23·6		23·6
12	,, ,, (coarse) ...	34·7	22·5		25·1
13	Superphosphate (200 lb. P_2O_5 per acre)	—	27·0		23·0
14	Superphosphate (50 lb. P_2O_5 per acre)	—	25·9		12·3
15	Superphosphate (200 lb. P_2O_5 per acre)—1 ton of ground lime per acre	—	23·4		27·2
16	No manure	—	15·5		6·4
17	Open hearth basic slag : high sol.	91·2	22·5		28·8
18	,, ,, ,, fluorspar sol.	20·1	18·8		16·8
19	1 cwt. ferrous sulphate per acre...	—	13·6		6·4
E	Lime at rate of 1 ton per acre ...	—	—		5·4
F	Cambridge coprolites	25·0	—		15·1
G	Rough slag	—	—		10·4
H	Cleveland phosphate	18·9	—		19·0
K	No manure	—	—		5·0
L	Florida soft phosphate	—	—		13·0
	Average gain, Plots 1 to 5 and 7 to 13 and 15, 17 and 18, over plots 6 and 16	—	—	—	25 %
	Rainfall, May 1st till harvest (in inches)	—	2·25	1·78 †	5·34
	Date of cutting	—	July 8	—	Aug. 16

* Phosphates not applied till Feb. 28th.
† Rainfall, May 1st to June 30th.

The Basic Slags, and the Gafsa, Algerian, and Egyptian phosphates, were from the same bulk as those used in the previous experiments.

The various phosphates were applied too late in 1918 for them to have much effect that season. During 1919, a dry season, the

plots were grazed by cattle and sheep in order to secure a close grazing bottom and so protect and keep the surface soil cool. In 1920 the meadow was reserved for hay, and throughout the season the plots were visited at least every week, a close watch being kept on the progress of the various plots. The high soluble slag and the " superphosphate and lime " plots were the first to make a start, followed by the plots that received the finer ground rock phosphates. During the whole of May the superiority of the plots receiving the finer ground rock phosphates over those receiving the same phosphates, only more coarsely ground, could be distinctly seen. As the season progressed the distinction became less and less visible, until at the beginning of July it was quite impossible to see any difference.

The high soluble basic slag (Plots 5 and 17), and Plot 15 (superphosphate and lime), were distinctly ahead during the whole season, but the rock phosphate plots gradually lessened the difference as the season progressed, although they never actually succeeded in catching up.

When the wild white clover came into flower the effect was remarkable. Figs. 4 and 5. showing Plot K (untreated) and Plot H (Cleveland phosphate) give some idea of the contrast which met the eye. So thick was the crop of wild white clover that the farmer decided to cut the plots for seed.*

Plots 1-19 are strictly comparable, having been sown at the same time, and a useful comparison of the effectiveness of the various phosphates may be made from the yields of hay.

There can be little doubt that the highest soluble types of open hearth basic slag and basic superphosphate are the most effective phosphates at Horndon. Some of the rock phosphates, however, were nearly as effective. The hard American Florida Pebble phosphate was inferior to the softer North African phosphates, as not only was shown in the weights of hay, but was plainly to be seen on walking over the plots.

No gain from fine grinding is apparent in the weights of hay, but an earlier start was undoubtedly made by the plots receiving the finer ground phosphate, and where a meadow is reserved for grazing it is possible that the extra cost of grinding would be well repaid.

The open hearth fluorspar slag, after giving promising results during the first two years, proved a poor plot in 1920 when compared with the high soluble slag, Plot 17. All the rock phosphate

* Only the *plots* were cut for hay, and no attempt was made to harvest the rest of the field, as the crop was not considered to be worth the labour involved in doing so.

plots, with the exception of the two receiving Florida Pebble, were much superior to the open hearth fluorspar basic slag.

Plots C and E unmistakably show that lime without phosphate has little or no effect in improving this type of pasture.

It is difficult to interpret the results from Plots B, D, F, G, H and L. They were not sown until 1919, and the exceedingly dry season prevented a rapid response.

It has been quite obvious during the past two years that the light dressing of superphosphate on Plot 14 has not been effective. The improvement was much less than the weight of hay would appear to indicate, and during the seasons 1919 and 1920 Plot 14 looked very like an untreated plot. The heavy dressing of superphosphate on Plot 13 was much more effective. It was not, however, nearly so good as the high soluble slag plots or the "superphosphate and lime" plot. Even on a soil of this character, very deficient in phosphoric acid and with a small reserve of calcium carbonate, an acid manure like superphosphate is not suitable. On Plot 15 the same dressing of superphosphate as on Plot 13, namely 200 lb. P_2O_5 per acre, and one ton of lime per acre, were sown together. Under such circumstances the reversion of the water-soluble phosphate in the superphosphate would be practically instantaneous and the dressing would become a basic one comparable to the application of a dressing of basic superphosphate. It is of interest to note that Plot 15 gives results practically identical with those secured on the plots receiving the most soluble type of basic slag. A close observation was kept on Plots 15 and 17 throughout the 1920 season, and the only noticeable difference was the somewhat earlier start made by Plot 15. The difference in this respect was not great, probably not more than 7 to 10 days, and had visits to the plots been less frequent, might have been entirely overlooked.

Butcher's Farm, Lambourne End: London Clay.—Towards the end of 1918 the writer was offered, through the courtesy of Dr. J. E. Stead, a small quantity of two open hearth basic slags from the same steel works but of widely different solubilities.

As a fair comparison could not be obtained by adding plots to any of the seven experimental centres then in progress it was decided to start a new experimental centre.

The phosphates applied to Plots A, 1, 2, 4, 5, 6 and 9 were drawn from the same bulk as those used in the previous experiments.

TABLE 4.—WEIGHT OF HAY AT BUTCHER'S FARM, LAMBOURNE END.

Manures sown: January 19th, 1919.

Plots ¼ acre	MANURE 200 lb. P_2O_5 per acre	Citric solubility of the phosphate, per cent.	HAY (in cwt. per acre) 1919	1920	1921	Average 3 years
A	Cambridge coprolites ...	25	25·0	32·3	3 33	30·2
1	Open hearth (fluorspar) basic slag	20	26·6	34·7	38·5	33·3
2	Open hearth basic slag ...	91	24·5	36·2	31·0	30·6
3	No manure	—	13.2	21·4	18·4	17·7
4	Egyptian phosphate ...	35	18·0	34·4	27·4	26·6
5	Florida pebble phosphate ...	18	16·9	37·8	30·5	28·4
6	Tunisian phosphate ...	24	19·0	38·1	34·0	30·3
7*	Open hearth (fluorspar) basic slag (Wigan) ...	32	16·0	34·1	29·4	26·5
8*	Open hearth basic slag (Wigan)	80	23·7	38·0	28·5	30·1
9	Cleveland phosphate ...	19	19·9	38·9	34·4	31·1
	Rainfall, May 1st till harvest (in inches)	—	3·08	5·27	2·44	
	Date of cutting	—	July 17	July 17		

* Plots 7 and 8 = $\frac{1}{10 \cdot 2}$ of an acre.

At Butcher's Farm the soil down to a depth of about 12 in. was of a fibrous peaty character, and, although it rested on a stiff London clay subsoil, the first 9 in. of soil resembled a sour peat loam. Scarcely a trace of leguminous plants has been visible on the untreated plot throughout, the hay consisting largely of water grasses and the type of weeds characteristic of sour soils. The soil had a high lime requirement (0.45 per cent.).

At this centre there have been no indications that high citric solubility is of any particular advantage. The open hearth fluorspar slag (Plot 1) which did so poorly at Martins Hearne and Horndon (Tables 2 and 3) gave quite as good results as the high soluble slag. The open hearth fluorspar slag used on Plot 7, in spite of the fact that it is more soluble than the one used on Plot 1, did not do so well.

The three rock phosphates have proved quite satisfactory. Florida Pebble which gave comparatively poor results at Horndon did much better on the sour soil at Butcher's Farm. The results at this centre suggest that on sour pastures and meadows there is little advantage to be gained from high citric solubility.

Field Experiments on Arable Land in Northern Ireland.—The Essex Experiments deal entirely with grass land, the conditions being materially different from those under arable conditions. In the former case the growing season is long, the manures can be conveniently applied in the autumn, and rapidity of action is not of such importance as on arable land.

In conjunction with Mr. D. R. Aiken, Mr. James Bradshaw, Mr. H. S. Cuthbertson, and Mr. P. T. O'Hare, County Agricultural Instructors for Londonderry, Armagh, Down, and Antrim respectively, a series of rotation experiments was begun in Northern Ireland in the spring of 1921 with the object of obtaining information as to the value of Gafsa phosphate under arable conditions. The manures were applied to the turnip crop in the drill in April.

TABLE 5.—ROTATION EXPERIMENTS WITH VARIOUS PHOSPHATES.

—	ANTRIM.				ARMAGH.		DOWN.				LONDONDERRY.	
	No farmyard manure.				With farmyard manure.		With farmyard manure.				With farmyard manure.	
	Cloughmills.		Ballynure.		Bessbrook.		Ballywalter.		Crossgar.		Drumaduff.	
	tons.	cwt.	tons.	cwt.	tons.	cwt.	tons.	cwt.	tons.	cwt.	tons.	cwt.
No phosphates ...	1	14	only 3 turnips		30	5	24	6	14	4	25	13
Superphosphate ...	18	0	35	12	34	7	25	10	25	7	28	8
Gafsa phosphate ...	16	10	39	3	32	0	27	6	27	18	28	0
Basic Bessemer slag	18	15	38	6	—		—		—		—	
Open hearth high sol. slag... ...	16	15	38	12	3		26	8	28	3	28	4
Steamed bone flour	19	10	—		—		25	10	25	14	29	1

In the Antrim Experiments no farmyard manure was applied, but in its place each plot received 1½ cwt. sulphate of ammonia and 1½ cwt. muriate of potash per acre. The dressing of phosphate was equivalent to 200 lb. of phosphoric acid per acre (approximately 10 cwt. of 40 per cent. slag).

In Counties Armagh, Down and Londonderry the plots received a dressing of 15 tons per acre of farmyard manure. With the exception of the various phosphates no other artificials were applied. At these centres the phosphates were applied at half the previous rate, *i.e.*, at the rate of 100 lb. of phosphoric acid per acre, approximately equivalent to 5 cwt. of 40 per cent. slag per acre.

At Bessbrook, Ballywater, and Drumaduff the response to phosphates after the application of farmyard manure was so small as to make the results of no value as a measure of the relative efficiency of the various phosphates.

At Cloughmills, Ballynure, and Crossgar there has been a striking response to phosphates. The soil at Cloughmills is a medium loam, at Ballynure a light loam and at Crossgar a light sand. At Cloughmills superphosphate and basic Bessemer slag had a slight advantage over the Gafsa phosphate. At Ballynure the Gafsa phosphate gave slightly the better result. At this centre the basic phosphates have done uniformly better than superphosphates. The failure of the crop in the absence of phosphates is striking. The farmer, Mr. W. McC. Barklie, J.P., emphatically stated at the commencement of the experiment that we would not get a crop on the "no phosphate plot." The turnip plants brairded satisfactorily, but with the exception of three plants they failed to make any further growth.

On the light sandy soil at Crossgar a very satisfactory response of from 11 to 14 tons per acre followed the addition of phosphates to dung. At this centre also there was no practical difference between the return from Gafsa phosphate and from high soluble slag. There is evidence that under the conditions at Crossgar they are both to be preferred to superphosphate.

The Irish experiments are only in the preliminary stages and it is not the purpose of the writer to draw definite conclusions from them. They do, however, show that the results obtained with rock phosphates on grass land in Essex are applicable to certain arable soil conditions. In continuance of this work a further series of rotation experiments with rock phosphates and two big grazing trials were laid down in the spring of this year by the Ministry of Agriculture for Northern Ireland.

Conclusions from the Field Experiments.—1. *Open Hearth Fluorspar Basic Slags.*—On the whole the results must be taken as showing that these slags are not as effective as the high soluble types. They have, however, a considerable value, and are not so bad as the solubility figures would suggest. Where the rainfall is high and the soil sour their effectiveness may closely approximate to that of the more soluble types. Where the soil is not decidedly sour and where the rainfall is low their inferiority is more clearly marked. For the manuring of grass land the writer is of opinion that if the value of the high

soluble slags is taken as 100 then the fluorspar basic slags have a value of from 50 to 70.

2. *Rock Phosphates*.—The results of all the experiments agree in showing that rock phosphates have a much higher manurial value than has hitherto been admitted. On sour soils and where the rainfall is high there is a certain amount of evidence which suggests that they may even prove superior to the best grades of basic slag. Even under conditions which favour high solubility (low rainfall and a sweet soil), as at Horndon, their value as a source of phosphate for the manuring of grass land is very close to that of high soluble basic slag. In every experiment they have proved more effective than the open hearth fluorspar slags.

Of the various types of rock phosphate Gafsa seems to be the most suitable for direct application. There is evidence that on sweet soil, or where the rainfall is low, the more soluble types of North African phosphates, *e.g.*, Gafsa, Egyptian, Algerian, and Tunisian, are superior to the richer, less soluble and harder types such as Florida Pebble.

* * * * * *

BASIC SLAG:

SECOND INTERIM REPORT OF THE PERMANENT COMMITTEE.*

THE Permanent Committee recently presented to the Minister the following second interim report on their experiments and deliberations during 1921:—

The reference given us was to consider the development and improvement of the manufacture of basic slag and the extension of its use. In considering these questions we have been compelled to give some attention to other phosphatic manures (viz., raw phosphates) both from the point of view of their being mixed with basic slag so as to supplement supplies of the latter, and also of ascertaining how various grades of basic slag compare with raw phosphates in agricultural value.

The basal facts in the situation are as follows:—

1. **Demand for Basic Slag.**—The demand for ground basic slag by the farmers of the United Kingdom has increased since the pre-war period (1912) from 290,000 tons to some 400,000 to 500,000 tons (with phosphate content of 11,000,000 to 12,500,000 units) per annum, and in the view of competent agricultural

* An abstract of the First Interim Report appeared in the September, 1921, issue of the *Journal*, p. 521.

experts it ought still further to increase. The figures are as follows, in tons per annum :—

	Pre-War Consumption. (1912.)	*Deliveries† (Year ending May 31st)*			*Expert estimate of quantity that could be consumed.*	
		1919.	*1920.*	*1921.**	*Sir T. H. Middleton.*	*Sir A. D. Hall.*
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
England and Wales ...	—	433,000	407,000	328,000	890,000	975,000
U. Kingdom	200,000	539,000	503,000	400,000	(33,820,000 units.)	(37,050,000 units.)

The 1921 figures show a depression which is readily explained and will, we hope, prove temporary only.

2. **Production of Basic Slag.**—On the other hand the production of unground basic slag has not correspondingly increased. Prior to the war it was about 400,000 tons; it rose in 1919-20 to some 701,000 tons, but in 1920-21 was less than 400,000 tons,* and in 1920 and 1921 was substantially less than the farmers' demands. Moreover, there has been a reduction in quality; in consequence of the supersession of the Bessemer process by the Open Hearth process the slag now obtainable contains on an average only half the percentage of phosphate of pre-war days, and much of it shows reduced solubility according to the official tests.

3. **Imported Basic Slag.**—The demands of the farmer have been met to some extent by importation from abroad. Thus, while in 1913 the balance of exports over imports was 114,000 tons, in 1920 and 1921 the balance of imports over exports was 6,000 tons and 38,000 tons respectively (a certain proportion of which was unground). Export has, however, in these years been prohibited except by licence.

In view of the likelihood that the quality of basic slag manufactured on the Continent may decrease as it has in the United Kingdom following upon a similar change in process of manufacture, and further that the demands of farmers abroad may increase, it would be unwise for farmers in this country to rely to any serious extent on importation.

The chief results of our deliberations during the year are set out below.

4. **Possibilities of Increased or Improved Production.**—After careful investigation we are being reluctantly forced to the conclusion that little, if any, change in blast furnace or steel furnace

* Much affected by the coal stoppage and the slackness of the steel trade.

† The actual consumption of basic slag has recently been slightly greater than the figures of deliveries shown, owing to the fact there has been an excess of imports over exports.

procedure is likely to be made with the purpose of improving either the output or the quality of slag. We are compelled to recognise that from the steel makers' point of view basic slag is relatively unimportant. On the average rather less than 4 cwt. are obtained for each ton of basic steel produced, and while a ton of steel has been worth from £27 in 1920 to £10 in 1921, the 4 cwt. of slag are worth not more than 2s. to the steel makers (and only about 6s. at makers' works even after the slag grinder had graded, ground and bagged the slag). The steel maker cannot afford to alter his processes in any way that would lengthen them or make them more costly or hazardous. The practical result is that the composition of basic slag is determined by the conditions under which the steel maker is working, and the total amount producible is regulated by the demand for steel; neither of which factors is in any way within the control of the agriculturist or influenced to any appreciable extent by his demands.

Various possibilities, such as the reintroduction of low grade slags into the blast furnace, the use of ores containing more phosphorous, etc., have been examined. Some of these methods are in partial use, where local conditions favour them, but any wider application is ruled out by the increased consumption of fuel which is usually necessary, and which is frequently accompanied by decreased output of the blast furnaces and in consequence increased cost of the pig iron.

5. **Remedies for Shortage.**—Having established the facts that the output of slag is less, and likely to remain less, than could advantageously be used by farmers, and that we can neither expect any increase in quantity of slag apart from increased output of steel, nor look to the steel makers to improve its quality, we are investigating the possibility of increasing the effectiveness of basic slag and the possibility of finding effective substitutes in ground mineral phosphates.

(*a*) *Effectiveness of Slag.*—One of the slags tested in the field in 1921 gave considerably better results than could have been anticipated from its chemical composition. We are going closely into this matter to see if any improvement in effectiveness is possible.

(*b*) *Substitution of Mineral Phosphates.*—The preliminary survey of last year has shown that the use of ground mineral phosphates would afford a ready means of solving this difficult problem. We have begun a careful inquiry into the fertiliser value of these phosphates.

(i) We have included a typical North African mineral phosphate in our trials at Rothamsted, and have arranged for a trial with Nauru phosphate.

(ii) We are keeping in close touch with, and are repeating side by side with our own experiments at Rothamsted, the experiments on mineral phosphates and basic slag now being carried out in various counties by the agricultural organisers under the ægis of the Agricultural Education Association, and this is facilitated by the circumstance that the Chairman of your Committee is also Chairman of the Experiments Committee of the Association.

6. **Field Trials.**—Owing to the exceptionally severe drought of 1921 very few results were obtained in any of the field trials, and in any case the trials must extend over several seasons before we can put forward definite conclusions.

So far as our present information goes:—

(*a*) The high soluble open hearth basic slags have the same agricultural value per unit of phosphoric acid as the old Bessemer slags.

(*b*) The low soluble slags have a smaller value, but in some circumstances the difference is not markedly great. There is, however, considerable diversity in effectiveness, and we have reason to believe that this group includes materials of very different natures, though the citric solubility test fails satisfactorily to distinguish between them.

(*c*) The mineral phosphates also have a smaller value, but again in some circumstances not as much less as might have been expected.

It is hoped that as a result of these trials we may ultimately be able:—

(1) To map out the country into regions where the high soluble slag can, and where it cannot, effectively, be replaced by low soluble slags and mineral phosphates;

(2) To advise the Ministry whether the annual output of some 70,000 to 140,000 tons of very low grade slag (under 15 per cent. phosphate) at present not recommended for use by the farmer, could with advantage be used after being admixed in any way with mineral phosphates.

7. **Solubility Test.**—Our experience with slags of different solubilities leads us to conclude that the official solubility test needs revision.

* * * * * *

LIVE STOCK AND HORSE BREEDING IMPROVEMENT IN ENGLAND AND WALES.

REPORT FOR THE YEAR 1921-22.

Live Stock Scheme.—The aims and objects of the Live Stock and Horse Breeding Improvement Schemes of the Ministry of Agriculture and Fisheries, and the steps taken to secure them, were so fully described in the recently issued Report of Sir Daniel Hall on the work of the Intelligence Department of the Ministry for the two-year period ending 31st March, 1921, that it is not necessary to explain again the reasons for the Schemes or the lines on which they are conducted. Those interested in the Schemes and horse and stock breeders generally may, however, wish to know the results for the year ending 31st March, 1922, and to compare them with those of previous years.

The Live Stock Scheme has now been in operation for eight years, and a review of what it has accomplished in face of serious difficulties, to which full reference has been made in previous reports, amply justifies its inception and vindicates its continuation, notwithstanding the call for economy in every branch of national expenditure. The new importance given by the War to the live stock industry as a source of food supply, and the imperative necessity for improvement in the methods that have satisfied the non-pedigree breeder for so long, are beginning to be realised by the farming community. To meet this need the Ministry's scheme has sought to demonstrate the value of a good sire and has assisted farmers by means of grants to obtain the services of such animals at reasonable fees. It has also, by giving financial assistance to societies formed for the purpose, encouraged the keeping of milk records which enable farmers to weed out unprofitable cows and thus grade-up their dairy herds. How much the scheme has progressed on these lines will be readily seen from the figures given in this report. The location of so many approved sires throughout the country must have a beneficial influence on the type of stock reared, and a satisfactory feature of the scheme is the improvement in the sires provided and the readiness of farmers to pay higher service fees.

The Committee on National Expenditure—commonly known as the Geddes Committee—recommended very considerable reductions in the expenditure on the Live Stock Schemes, but after full consideration the Government decided that no " cut " need be made in the subsidy to Milk Recording, Bull and Boar Societies. In view, however, of the urgent necessity for reduction in public expenditure the Ministry had reluctantly to discontinue its grants this season to Heavy Horse Societies, but as the majority of the societies subsidised were not in an unsatisfactory financial condition and had learnt the value of using good sires and of co-operating to secure the provision of them, it is hoped that the societies will continue their good work even though financial assistance from the Ministry is no longer possible. In this connection it may be pointed out that the Heavy Horse Scheme was initiated in 1914 with the object, *inter alia*, of discouraging the use of the unsound travelling stallion whose popularity was mainly due to his low fee. As, however, the unsound travelling stallion has been driven off the road by the operation of the Horsebreeding Act, 1918, it will be recognised that the need for the Heavy Horse Scheme is not so great now as it was when originally brought into operation. Its discontinuance is nevertheless regretted.

The progress made by the Boar, Bull and Milk Recording Schemes is satisfactory, and the following details may be of interest :—

Year.	Boars.			Bulls.			Horses.	
	No. of		Total Animals	No. of		Total Animals		
	Societies.	Individuals.	Boars.	Societies.	Individuals.	Bulls.	Societies.	Stallions.
1914—15*	115	nil	115	369	43	497	65	72
1915—16	180	nil	193	489	28	633	88†	97
1916—17	186	15	216	543	15	659	93†	108
1917—18	172	92	264	578	14	710	94†	110
1918—19	156	167	350	604	7	721	101†	122
1919—20	120	225	399	568	6	675	93†	118
1920—21	135	285	441	561	6	668	86†	105
1921—22	113	416	550	726	3	847	83†	101

* Including the period 1st February, 1914—31st March, 1914.

† Excluding the Cumberland and Westmorland Heavy Horse Society formed in 1915—16, which issues assisted nominations only.

Milk Recording.

Year.*		Societies.	Members.	Herds.	Cows.
1st April to 31st March	1914-15	16	264	306	7,331
	1915-16	20	350	398	9.811
	1916-17	22	441	495	12,950
	1917-18	25	503	555	14,404
1st October to 1st October	1917-18	27	639	708	19,793
	1918-19	38	1,191	1,332	37,880
	1919-20	46	2,075	2,312	61,323
	1920-21	52	3,328	3,664	97,903

* Prior to 1st October, 1917, there was no uniform year for Societies.

Boars.—Further substantial progress has been made by the Boar Scheme during the year ended 31st March, 1922. There has been a slight fall in the average price paid for all breeds except Berkshire and Essex, in which cases there was a marked increase, but the numbers of boars of these breeds are small. The service fees again show an upward tendency and, as illustrating the sow owners' willingness to pay more for a good sire, the point is worthy of notice. Another interesting feature of the following table is the inclusion of four breeds that were not represented in the early years of the Scheme. It has been pointed out in previous reports that the Live Stock Scheme has had the direct result of the establishment of new herd books, and in this connection the Gloucester Old Spots and the Cumberland breeds appear to be growing in popularity. A Gloucester Old Spots Boar provided during the year had an estimated value of

Number and Average Prices of Boars.

Breed.	1914-15		1920-21		1921-22	
	No.	Price.	No.	Price.	No.	Price.
		£ s. d.		£ s. d.		£ s. d.
Berkshire	10	8 0 0	5	18 15 10	11	23 19 10
Cumberland	—	—	28	19 9 7	32	17 11 10
Essex	—	—	2	30 0 0	7	33 11 5
Glos. Old Spots	7	7 0 0	51	23 12 7	51	21 4 4
Lincoln Curly Coat ...	4	8 0 0	17	14 14 0	24	13 0 4
Large Black	18	7 0 0	129	18 8 0	157	17 3 6
Large White	64	7 0 0	117	18 11 0	167	17 5 1
Middle White	12	7 0 0	35	20 13 0	62	19 4 3
Tamworth	—	—	2	19 0 0	1	17 0 0
Wessex Saddleback ...	—	—	7	34 15 4	11	22 16 11
Other Breeds	—	—	1	15 0 0	—	—
All Breeds	115	7 0 0	424	19 9 5	523	18 3 0

Service Fees.

Year.	2/-	2/6	3/-	3/6	4/-	4/6	5/-	5/6	6/-	6/6	7/-	7/6	8/-	8/6	10/-	Over 10/-
1914—15 ...	21	62	10	5	6	—	2	—	–	—	—	–	—	—	—	—
1920—21 ...	3	19	17	23	38	6	194	—	34	3	4	52	2	—	15	9
1921—22 ...	1	10	13	13	36	6	215	1	42	5	7	111	3	3	22	10

£100, which with an Essox boar which cost a like amount represents the highest figure for the year. As many as 161 boars cost as much as £20 or over.

Subsidised boars and their progeny have again scored many successes at shows.

Bulls.—After the successive decreases recorded in the number of bulls provided during the years 1919-20 and 1920-21 it is satisfactory to note that there was a very marked increase in the number available during the year ended 31st March, 1922. There was, as in the case of boars, a general decrease in the average prices paid for the various breeds, and a general rise in the number of service fees of 5s. and over. The highest price paid for a bull provided under the Scheme was £483 for a

Number and Average Prices of Bulls.

Breed.	1914–15.				1920–21.				1921—22.			
	No.	Price.			No.	Price.			No.	Price.		
		£	s.	d.		£	s.	d.		£	s.	d.
British Friesian	1	37	0	0	1	126	0	0	7	78	18	7
Devon	16	41	0	0	53	68	12	2	70	64	9	2
Guernsey	—	...			3	65	0	0	6	54	4	2
Hereford	63	33	0	0	66	70	5	2	78	68	15	2
Linc. Red	33	32	0	0	69	75	19	10	89	73	1	8
Shorthorn...	337	38	0	0	403	79	9	11	492	76	5	10
Red Poll	—	—			—	--			1	78	15	0
South Devon	6	37	0	0	15	76	15	4	20	69	5	2
Welsh Black	35	29	0	0	48	58	18	0	60	57	2	7
Other Breeds	6	28	0	0	1	68	5	0	--			
All Breeds	497	36	0	0	659	75	15	1	823	72	10	5

Service Fees.

Year.	2/6	3/-	3/6	4/-	4/6	5/-	5/6	6/-	6/6	7/-	7/6	8/-	8/6	9/-	9/6	10/-	Over 10/-
1914—15 ...	265	57	41	42	8	88	—	—	—	—	1	—	—	—	—	—	—
1920—21 ...	62	43	37	81	6	269	2	33	2	2	84	2	—	—	—	28	8
1921—22 ...	46	38	26	74	7	346	1	48	3	6	160	6	4	2	—	51	6

Shorthorn, while as many as 97 cost £100 or over. The fact that these high prices are paid willingly is evidence that the objects of the Scheme are being more understood and appreciated. Premium bulls and their offspring have done exceedingly well at shows. Indeed, it was almost invariably the case that where subsidised sires appeared at shows they figured largely in the award list. The following instance may be noted as typical of many. At the Danby Agricultural Society's Show on 18th August, 1921, there was a large show of premium bulls from the district and practically all the prizes were carried off by bulls in respect of which grants had been made by the Ministry. In one class for which a special prize was given for scheme bulls there were 9 entries, and the Live Stock Officer was personally complimented by the judges on the good quality of the exhibits.

Heavy Horses.—In view of the decision that grants to Heavy Horse Societies are to be discontinued it is of interest to review briefly the operations of this section of the Live Stock Scheme since its commencement. The following table shows that there was a general increase in the number of stallions provided, and mares served up to and including the 1918 service season, and a gradual decline since that year. This decline is due mainly to the fact that many societies have prospered sufficiently well to enable them to carry on without further

Year.	No. of Stallions	* Total No. of Mares served.	*Average No. of Mares served.	* No. of assisted nominations.	Average hiring fee of Stallions.	Average Service Fee.		
					£	£	s.	d.
1914-15 ...	72	6,365	68	1,503	231	2	8	6
1915-16 ...	97	9,122	94	2,430	241	2	9	6
1916-17 ...	108	9,995	92	2,181	244	2	11	0
1917-18 ...	110	10,556	96	2,151	258	2	16	3
1918-19 ...	122	12,281	100	2,165	285	2	15	8
1919-20 ...	118	10,920	96	1,996	317	3	6	3
1920-21 ...	105	9,133	87	1,839	345	3	13	1
1921-22 ...	101	7,888	78	1,943	333	3	13	7

* Excluding the Cumberland and Westmorland Heavy Horse Society, which was formed in 1916 for the purpose of issuing only assisted nominations to selected stallions. The figures for this Society were as follows :—

Year.	No. of Assisted Nominations.	Year.	No. of Assisted Nominations.
1915-16	386	1919-20	264
1916-17	394	1920-21	254
1917-18	328	1921-22	255
1918-19	321		

The decline in the number of assisted nominations issued by this Society is due to the increased service fees which automatically increased the value of an assisted nomination and consequently reduced the number available from the Ministry's grant.

financial assistance from the Ministry. Fully eighty per cent. of the societies subsidised by the Ministry were formed for the purpose of the Scheme, and in the year under review only 14 out of the 83 societies which received a grant under the Scheme were in existence prior to its commencement. Most of the societies are in a satisfactory financial position, and it is hoped that they will carry on without the Ministry's grant.

Sheep.—The limited financial assistance given by the Ministry in 1919-20 and 1920-21 to a scheme for the improvement of Welsh Mountain sheep was continued during 1921-22. Grants at the rate of 3s. 4d. per ewe served, up to a maximum of £10, were made to eleven societies in respect of 13 approved rams. 791 ewes were served, being an average of 61 per ram. The ram, ewes and the progeny are required by the Regulations to be earmarked. The average hiring fee of the rams was £10 6s. 2d. and the average service fee was 1s. 7d.

This scheme is very popular in the districts for which it was provided, and it is hoped to extend it as and when opportunity offers.

Milk Recording.—Notwithstanding any fears that may have existed as to the effect of the upward tendency of the cost of recording and particularly as regards the institution of a charge for certificates and the sudden drop in the price which the producer obtains for his milk, the Milk Recording Section of the Scheme has continued its progress. Six societies and 37,000 cows were added during the recording year 1st October, 1920—1st October, 1921. The movement has penetrated into practically every county in England, and in Wales where milk recording has more recently been taken up, there are only 4 counties not yet provided for.

The annual returns furnished by the 52 Societies for the recording year under review show that of the 97,903 cows and heifers recorded, 49 per cent. were animals which had been retained in the herds for the full year, and the average yield of these full-year cows was 6,562·95 lb.—a slight advance on the average for the previous year when the full-year cows, which represented 44 per cent. of the cows and heifers recorded, gave an average of 6,527·3 lb. The large influx of previously unrecorded cows at the commencement of the year has again tended to keep the average of full-year cows lower than may reasonably be expected in due course, but the averages shown in the following statement compare very favourably with the general average of all cows in milk throughout the country,

which, according to the finding of the Departmental Committee on the Production and Distribution of Milk was estimated at 436 gallons for the year 1918:—

Comparison of Average Annual Yield for Societies for the last four milk-recording years.

Year, 1st Oct.—1st Oct.	No. of Societies.	Particulars of all Cows and Heifers recorded.			Particulars of Cows recorded for full year.		
		No. of Cows and Heifers.	Total Yield (in gal.)	Average Yield (in gal.)	No. of Cows.	Total Yield (in gal.).	Average Yield (in gal.).
1917-18	27	19,793	8,426,958	426	8,755	5,255,924	599
1918-19	38	37,880	16,204,941	450	17,989	10,543,516	579
1919-20	46	61,323	29,344,887	479	27,266	17,363,347	637
1920-21	52	97,903	48,512,380	495	48,248	30,892,620	640

As an illustration of the progress that has been made by individual societies the following particulars of the largest Society (Essex) under the Scheme are of considerable interest:—

Year.	Particulars of all Cows and Heifers.			Particulars of Cows recorded for full year.		
	No. of Cows and Heifers.	Yield (in gal.).	Average Yield (in gal.).	No. of Cows.	Yield (in gal.).	Average Yield (in gal.).
1917-18	640	342,260	534	407	259,331	637
1918-19 ...	3,529	1,811,075	513	2,141	1,314,709	614
1919-20	4,412	2,299,612	521	2,226	1,516,153	681
1920-21	6,427	3,566,124	555	3,543	2,500,971	708

The following example of the great difference which exists between herds in their milk producing value is of interest. Two members of the same society had 42 cows each. All were recorded for the full year. The average yield of the 42 cows in one herd was 9,117 lb. and of the other 3,812 lb. The approximate difference in the total yield was 21,733 gallons, which at 1s. per gallon represents a difference of £1,086 for the same number of cows.

The charge which was placed on milk record certificates in accordance with the recommendation of Sir Beville Stanier's Committee resulted as was expected in a great decrease in applications for certificates: 4,374 certificates were issued as compared with 16,425 in the preceding year. The decrease is considerable, but the falling off of about 3,500 applications in respect of yields of less than 6,000 lb. affords little ground for regret.

The following Table shows the classification of yields of cows which have been certified by the Ministry for each recording year, since 1st October, 1917 :—

Year.	No. of Certificates issued.	1 to 1,000 lb.	1,001 to 2 000 lb.	2,001 to 3,000 lb.	3,001 to 4,000 lb.	4,001 to 5,000 lb.	5,001 to 6,000 lb.	6,001 to 7,000 lb.
1917-18	4,178	1	3	18	47	186	522	1,099
1918-19	7,373	5	6	32	121	371	1,353	2,111
1919-20	16,425	—	19	70	224	657	3,015	4,069
1920-21	4,374	11	12	21	35	89	356	686

Year.	No of Certificates issued.	7,001 to 8,000 lb.	8,001 to 9,000 lb.	9,001 to 10,000 lb.	10,001 to 11,000 lb.	11,001 to 12,000 lb.	12,001 to 13,000 lb.	13,001 to 14,000 lb.
1917-18	4,178	1,031	723	324	131	59	20	8
1918-19	7,373	1,565	1,044	464	173	73	33	14
1919-20	16,425	3,491	2,514	1,254	648	252	96	46
1920-21	4,374	806	1,084	613	339	169	67	38

Year.	No. of Certificates issued.	14,001 to 15,000 lb.	15,001 to 16,000 lb.	16,001 to 17,000 lb.	17,001 to 18,000 lb.	18,001 to 19,000 lb.	19,001 to 20,000 lb.	20,001 to 21,000 lb.
1917-18	4,178	4	2	—	—	—	—	—
1918-19	7,373	4	—	1	2	—	1	—
1919-20	16,425	19	9	8	2	2	—	2
1920-21	4,374	14	13	6	6	6	2	1

The fifth volume of the Ministry's Annual Register of Dairy Cows with authenticated milk records for the year ended 1st October, 1921, contains particulars of 2,441 cows (belonging to 493 members) in respect of which certificates have been issued by the Ministry showing that they have yielded 8,000 lb. or more during the year, or an average of 6,500 lb. or more during that year and one or more preceding consecutive years. Thirteen recognised breeds or types are represented in the Fifth Volume, and there are in addition 142 cross-bred cows whose milk yields have reached the prescribed standard.

Of the 2,441 cows entered 2,028 gave over 8,000 lb. of milk during the year, and 413 were entered on an average of 6,500 lb. or over. Of the 2,028 cows which were entered on the one year's yield, 931 gave between 8,000 and 9,000 lb.; 521 between 9,000 and 10,000 lb.; 290 between 10,000 and

11,000 lb.; 147 between 11,000 and 12,000 lb.; 58 between 12,000 and 13,000 lb.; 37 between 13,000 and 14,000 lb.; 14 between 14,000 and 15,000 lb.; 13 between 15,000 and 16,000 lb.; 8 between 16,000 and 17,000 lb.; 6 between 17,000 and 18,000 lb.; 5 between 18,000 and 19,000 lb.; 2 between 19,000 and 20,000 lb. and 1 over 20,000 lb.

The Calf Marking Scheme, which is an essential factor in the grading up of recorded cows, has now been taken up by 52 of the 55 Milk Recording Societies.

An examination of the financial statements furnished by societies again revealed an increase in the average cost per cow both to the society and to the member.

It is probably an indication of the commercial value of milk recording that this tendency toward increasing cost has not constituted a serious deterrent to the extension of the practice. This value has been frequently demonstrated by the prices realised at sales for recorded non-pedigree cows. The following are the results of a few of the sales of non-pedigree cattle reported to the Ministry, and in view of the drop in the value of stock the prices obtained may be considered satisfactory.

At the Lancashire County Milk Recording Society's second annual Spring Show and Sale at Preston on 17th March, 1921, 45 non-pedigree Shorthorn cows realised an average price of 58 guineas, the highest prices being 100 (twice) and 90 guineas.

At the Sale on 23rd March, 1921, of the herd of a member of the Berkshire Milk Recording Society, 39 non-pedigree Shorthorn cows and heifers realised an average of 58 guineas, one cow fetching 155 guineas.

Fifty-five non-pedigree cows and heifers realised an average of 60 guineas at the sale of a herd recorded by the Oxfordshire Milk Recording Society on 31st March, 1921. The highest prices were 120, 101 and 90 guineas.

At a Sale on 4th October, 1921, of a recorded herd owned by a member of the North West Wilts Milk Recording Society the average price obtained for 99 non-pedigree cows and heifers was 59 guineas. The highest prices for cows and heifers were 220, 105 (three times) and 100 (three times) guineas, and for calves 100, 45 and 38 guineas.

Forty non-pedigree Shorthorn cows and heifers averaged 69 guineas at the Sale on 7th October, 1921, of a herd recorded by a member of the Hampshire Society. The highest prices were 120, 110, 100 (twice) guineas.

At the Lancashire Milk Recording Society's fourth Annual Show and Sale on 10th November, 1921, 61 non-pedigree cows and heifers averaged 63 guineas. The highest prices were 100 (twice), 98, 93 and 90 (three times) guineas, and for the calves 49 and 42 guineas.

At a Sale of recorded non-pedigree cattle at Penrith on 11th November, 1921, 3 cows made 117, 95 and 94 guineas respectively.

On the 15th November, 1921, the herd of a member of the Kent Society was disposed of. Fifty-eight non-pedigree cows and heifers realised an average of 78 guineas, the highest prices being 120, 110 (twice), 108, 105, 102, 100 (four times) guineas. For calves the highest prices were 30 and 25 guineas.

The following are the principal memoranda used in connection with the livestock operations of the Ministry, and copies of them can be obtained free of charge, on application to the Secretary, Ministry of Agriculture and Fisheries, Whitehall Place, London, S.W.1.

Leaflet 282 ...	Scheme for the Improvement of Live Stock.
Leaflet 146 ...	The Value of Records of the Milk Yields of Cows.
No. 609/T.L. (L2) .	Bull Grant Regulations.
No. 392/T.L. (L4) .	Milk-Recording Regulations.
No. 446/T.L. (L11) .	Boar Grant Regulations.

Particulars of the Light Horse Breeding Scheme for the year ended 31st March, 1922, will be published in the October issue of the *Journal*.

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GRADING AND SIZING OF APPLES.

J. STODDART,

Ministry of Agriculture and Fisheries.

IN an article by Mr. J. Turnbull, published in the August issue of the *Journal*, mention was made of an improved type of hand-sizer which was being tested by officers of the Ministry. The writer is now able to describe and illustrate this apparatus and explain the considerations which brought about its production.

One of the greatest difficulties encountered in securing the adoption and use of the standard box for English apples has been the lack of a simple, efficient and speedy means of grading and sizing the fruit. Experience at many demonstrations of box packing indicates that the majority of growers desire some sort of apparatus which will separate the apples into definite sizes without the apprenticeship needed for eye-sizing, and that they prefer to fill and close one box at a time.

While weight-sizing is undoubtedly the most efficient method, machines for this purpose are necessarily costly and methods of sizing by diameter must be considered. In anticipation of

possible criticism of this method it is pointed out that, as few apples are truly circular on any section and in many varieties the length varies considerably in proportion to the transverse diameter, it is obvious that sizing by any one diameter cannot be accurate. Results, however, show that this approximate sizing enables a packer, after very little practice in the final sizing by eye, to fill boxes at a reasonable speed.

After some consideration and experiment the writer has been able to design and construct a simple hand-operated sizer which marks a substantial advance on the various ring, hole and peg methods hitherto used. As will be seen in Fig. 1 it consists of two curved walls attached to a baseboard in which is cut a slot corresponding to, but extending slightly beyond, the ends of the walls. The width of this channel, moving from left to right, is reduced by steps at regular intervals according to the number of sizes decided on, in this case five. A canvas-top table with five radial compartments is used, and on it the sizing board is placed, as shown in Fig. 2, each step in the channel registering with its respective compartment.

The operator sits or stands behind the sizing board with ungraded apples in a box on his left together with boxes in which to place the very large and blemished apples rejected. Another box is placed on the right to receive the very small apples which pass clear through the sizer.

In operation, the apples are picked up singly in the left hand, examined for blemish and passed to the right hand with the stem up. The apple, held between the thumb and fingers, is passed between the walls of the channel until, on account of the diminishing width, it stops at one of the steps. When this occurs all that is necessary is to release the apple, which falls into the compartment corresponding to its size, rolling towards the outer side of the table ready for the packer. In a very short time this operation can be done *by touch alone* so that *the whole of the operator's time and attention can be devoted to the important work of inspection.* As apples must, at some time or other, be handled singly for inspection, a great deal of time is saved when the sizing is carried on concurrently with this operation.

The sizer illustrated varies $\frac{1}{4}$ in. from step to step and delivers inspected apples which vary by $\frac{1}{4}$ in. on a transverse diameter. This is sufficiently close sizing for general purposes, the final sizing, as before explained, being done when filling the boxes. Where closer preliminary sizing is required the steps are graduated by $\frac{1}{8}$ in.

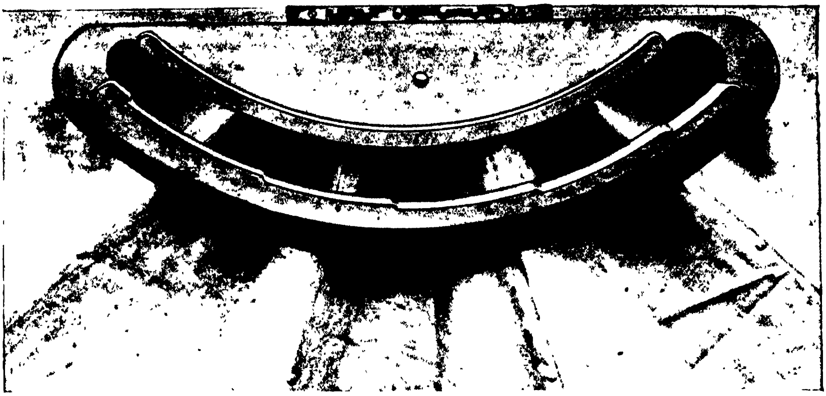

FIG. 1.—Sizing Board. Showing the two Walls attached to the Slotted Baseboard.

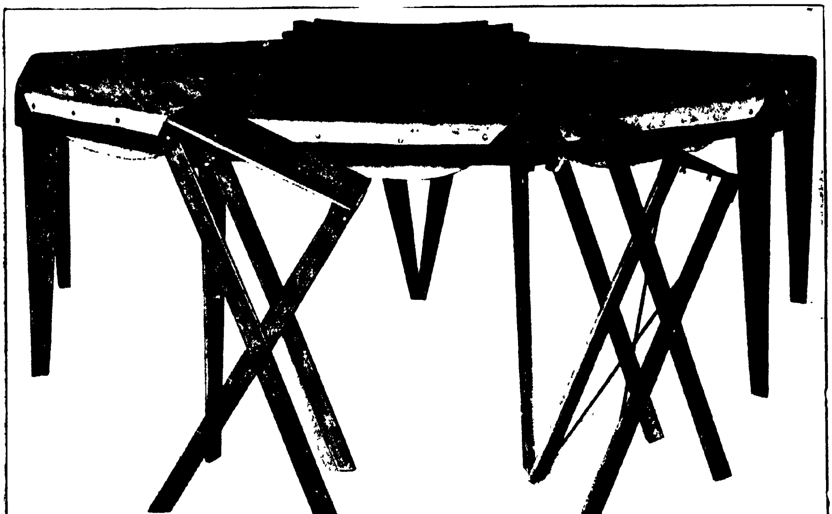

FIG. 2.—Grading Table, with canvas top, showing radial compartments and sizing board in position.

FIG. 3.—Apparatus folded for transportation, showing the small compass into which it can be packed.

Adjustment for the different sizes of varieties is easily made by placing one or more rubber bands, $\frac{1}{8}$ in. thick, on the inside of the inner wall of the channel, each band reducing the whole of the sizes by $\frac{1}{8}$ in. This arrangement is of great advantage when dealing with those varieties which are difficult to pack on regular sizes (*e.g.*, 3 in., $2\frac{3}{4}$ in., $2\frac{1}{2}$ in., etc.) as the insertion of a band produces intermediate sizes (*e.g.*, $2\frac{7}{8}$ in., $2\frac{5}{8}$ in., $2\frac{3}{8}$ in., etc.) when the difficulty usually disappears.

For the ease of transport necessary in demonstration work the apparatus illustrated has been designed to fold to a small compass (5 ft. by $1\frac{1}{2}$ ft. by 1 ft.) including the two box-stands (Fig. 3). While not really necessary for commercial work it is of advantage to a grower to be able to fold up and store away the apparatus when the season's work ends.

Anyone interested in the invention can obtain further information on application to the Ministry.

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THE ALLOTMENTS ACT, 1922.

THE provisions of the Allotments Act, which received the Royal Assent on the 4th August, 1922, not only deal with the administration of the Allotments Acts by local authorities and the provision of allotments by those bodies, but also make a number of amendments in the existing law, which will be of interest and importance to landowners and to the many thousands of allotment-holders in England and Wales.

It is not proposed in this note to deal exhaustively with the alterations in the law which directly affect local authorities and their administration. The Ministry will issue to such authorities a leaflet dealing fully with the whole of the provisions in the new Act. This note deals only with those provisions of the Act which directly affect private individuals.

It has hitherto been one of the chief grievances of allotment-holders that they were liable to be dispossessed of their plots on short notice, and although the existing legislation provided that the allotment-holders should be entitled to compensation for their crops, etc., this did not altogether meet their contention that, after putting a considerable amount of time and labour into the cultivation of their plots, they were liable to be dispossessed without being able to reap the full reward of their labours.

The basic position taken up in the new Act as regards allotment gardens (which expression is described as "an allotment not "exceeding 40 poles in extent which is wholly or mainly "cultivated by the occupier for the production of vegetables or "fruit crops for consumption by himself or his family") is that, *notwithstanding any agreement to the contrary*, the tenancy of such an allotment garden, or of land let to a local authority or association for the provision of allotment gardens, cannot in future be terminated by the landlord by notice to quit or re-entry except by a six months' or longer notice to quit expiring on or before the 6th day of April, or on or after the 29th day of September in any year. Moreover, if the tenancy of the tenant is terminated at Michaelmas (29th September) or Old Michaelmas (11th October), either by notice to quit given by the landlord, or by the termination of the tenancy of the landlord, the tenant will be entitled at any time within 21 days after the termination of the tenancy to remove any crops growing on the land.

To this general rule, however, there are some exceptions, where the circumstances are not those which ordinarily obtain. Where the land is required for building, mining, or any other industrial purpose, or for roads or sewers necessary in connection with any of these purposes, or where the land is required by the owners or lessees of a railway, dock, canal, water or other public undertaking for the purpose (not being the use of land for agriculture) for which it was acquired, or held by the corporation or company, or in the case of land let by a local authority (other than land acquired by the local authority before the 4th August, 1922, under the Housing Acts) on account of the land being required by the local authority for the purpose not being the use of land for agriculture for which it was acquired, the landlord can re-enter under a power of re-entry contained in or affecting the contract of tenancy after three months' previous notice in writing to the tenant of the allotment garden. Further exceptions are that where land is required by a statutory company or corporation of the kind mentioned above, in case of emergency, and in the case of land acquired under the Housing Acts before the 4th August, 1922, and required for the purposes of those Acts, re-entry can be made under a power in that behalf contained in or affecting the contract of tenancy after the expiry of such period of notice to the tenant of the allotment garden as is provided for in such contract of tenancy.

The above provisions of the Act do not apply to land held by or on behalf of the Admiralty, War Department or Air Council, when possession of land is required for Naval, Military, or Air Force purposes, or to tenancies of Defence of the Realm allotment gardens.

In the case of land let either *before or after* the passing of the Act for use by a tenant as an allotment garden, it is provided that the tenant will be entitled to compensation for crops and manure on the basis of the value to an ingoing tenant only if the tenancy is terminated by the landlord, and is so terminated either between the 6th day of April and the 29th day of September (the ordinary summer cropping season of an allotment garden) or by re-entry at any time in the exceptional circumstances set out above. In the case of land let *after* the passing of this Act to any local authority or association for the purpose of being sub-let for use by the tenants as allotment-gardens, the landlord will be liable to pay compensation to the local authority or association, notwithstanding that the crops have been grown and the manure applied by the tenants of the local authority or association. In future the compensation payable to a tenant of an allotment garden will be determined in default of agreement by a valuation made by a person appointed, if the parties cannot agree, by the judge of the County Court having jurisdiction in the place where the land is situated. These provisions take the place of the existing statutory provisions as to compensation for disturbance, or crops, etc.

The Act also gives a Borough or Urban District Council power to enter for the purpose of providing allotment gardens on land which is unoccupied at the date of the notice of entry, or which was unoccupied when possession was first taken by the Minister of Agriculture for the purpose of providing Defence of the Realm allotments. "Unoccupied" land means land which is not the subject of such occupation as would involve liability to the payment of the poor rate or any rate leviable in like manner as the poor rate. Any person who is interested in any land so entered upon and suffers any loss as the result of the Council's entry, can claim compensation by way of periodical payments or otherwise, the amount to be determind in default of agreement by a valuation made by a person appointed, if the parties cannot agree, by the Minister of Agriculture. The owner of any land so entered upon by a Council may terminate the Council's right of occupation by giving not less than two months' notice in writing in any case where the

land is required for any purpose other than the use of the land for agriculture.

If any question arises as to whether a landowner in good faith requires possession for a specified purpose (*e.g.* building) of land acquired or entered on by a local authority or let to an association for allotment gardens, the local authority or association may refer the question to arbitration. The landlord must state in writing the purpose for which re-entry is required, and the appeal must be made within ten days after receiving this notification. This appeal does not apply to land let by a railway, dock, canal, water or other public undertaking.

The Act also provides that the Council of every Borough or Urban District with a population of 10,000 or upwards, shall, unless exempted by the Minister of Agriculture after consultation with the Minister of Health, establish an Allotments Committee (which may be an existing Committee of the Council or a Sub-Committee of an existing Committee) to which all allotment matters except the power of raising a rate or of borrowing money shall stand referred. This Committee must comprise persons other than members of the Council representative of the interests of occupiers of allotment gardens in the borough or district, provided that the number of such representative members shall be not more than one-third of the total number of the members of the Committee or be less than two or one-fifth of such total number whichever be the larger.

Until the 31st December, 1922, Orders made for the compulsory acquisition of land for allotments will, subject to certain exceptions, not require confirmation by the Minister of Agriculture.

Unless an acquiring authority serves notice to treat under an Order within three calendar months of the making of the Order it will become null and void.

The Act also provides that, in future, allotments provided by a Council shall be let at the full fair rent for such use, but Councils are still required to act on the principle that the whole of their allotments undertaking is to be carried on upon a self-supporting basis except that acquisition expenses (such as legal costs), the cost of making public roads, and sinking fund charges in respect of loans raised in connection with the purchase of land, need not be included as expenses for the purpose of drawing up the balance sheet of their undertaking.

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THE REVIVAL OF VILLAGE INDUSTRIES:

THE OBJECTS AND WORKING OF THE COUNTRY INDUSTRIES CO-OPERATIVE SOCIETY LIMITED.

A. BOWMAN.

In the July issue of this JOURNAL *there appeared an article explaining the objects and working of the Rural Industries Intelligence Bureau. The following pages give a short account of the work of the sister organisation, The Country Industries Co-operative Society, Limited.*

IT was felt from the first both by the Development Commissioners and the Committee of the Rural Industries Intelligence Bureau that the formation of a co-operative trading society formed an essential part of any scheme for the assistance of the many crafts and industries scattered over the countryside. Hence the starting of the Country Industries Co-operative Society, Limited, which is registered under the Industrial and Provident Societies Acts, and is a business undertaking pure and simple. It is the wholesale trading body for all village industries and handicrafts throughout the country. The Society receives no subsidy or grants from the Government.

The members of the first Committee of Management are:—Sir Charles McLeod (Chairman), The Lady Denman, Sir Ernest J. P. Benn, Bart., Sir Basil E. Mayhew, Mr. Vaughan Nash, Mr. J. J. Dent and Mr. T. L. Coltman. This is a committee of very representative persons who give their time and services to the Society without remuneration. They are so confident of its ultimate success that they have a large financial interest in the undertaking.

The Society will work in close association with the Intelligence Bureau. The need for such a wholesale and central trading Society has long been felt, as too often the isolated, unprotected and unorganised workers have had to accept whatever price they could get for their products. This will now be remedied, as it is the intention of the Society to organise the workers in village groups, and link them up to a County Co-operative Society, so that by combination and production on an economic basis they will be able to hold their own with other trades and industries. This should not only secure them a fair reward for their labour, but also a reasonably permanent outlet, with facilities for giving

their products a standard and protection by trade marks and registered designs of the Society.

The objects of the Society are to carry on the trade of importers, manufacturers and dealers, both wholesale and retail, of or in any material and finished or unfinished articles required by workers in rural industries, and the sale or hiring of machinery, plant and equipment to workers, and the marketing of their productions, and generally to assist in the development of rural industries upon a sound economic and commercial basis. Its functions are therefore two-fold:—

(*a*) To supply raw material of every description, or half-finished goods or parts, at wholesale prices, to isolated workers or groups of workers engaged in rural industries and handicrafts; also to undertake where necessary, the hiring out of plant, and equipment such as hand-looms, sewing machines, tools, etc.

(*b*) To sell the articles and the materials made by rural workers and handicraftsmen to the best advantage in markets not always accessible to scattered workers.

Anyone wishing to purchase raw material from the trading Society will be perfectly at liberty to dispose of the finished goods elsewhere if he chooses, and if he wishes to provide his own material it will still be open to him to ask the Society to sell his goods. This should be of great value to village workers, as they will be able to obtain the raw material which they require at rock-bottom prices, and so to compete more successfully with foreign goods.

As the Society is co-operative it is not out to pay large dividends to its shareholders; the interest upon share capital is fixed by the rules and must not exceed six per cent. per annum. It will readily be seen that the Society has been established mainly to benefit its producing members. After the provision of a reserve fund, the balance of the net profits will be divided as the Annual General Meeting may determine, so that the members have full power to dispose of the profits as they think fit.

The shares are of the nominal value of £1, and are transferable. They may be paid up in full on admission to membership, or at the discretion of the Committee, by instalments. Every member must take at least one share, and no craftworker will be able to say that the shares are of such a nature that they prohibit him from joining the Society. On the other hand, no individual member can hold a share interest exceeding £200.

A further rule provides that no political or sectarian discussion shall be raised or resolution proposed at either the Committee or

General Meetings of the Society. Everybody will welcome such a rule, as it should enable persons of all political opinions to join together for the common welfare and prosperity of rural districts.

The Society has purchased the lease of excellent premises having large showrooms and warehouse accommodation situated at 258 to 262, Westminster Bridge Road, London, S.E.1. It is a corner building exactly opposite the New County Hall of the London County Council. In the various departments there will be on show samples of materials and parts required by all craft-workers. There will also be an extensive and permanent exhibition of all goods produced for which a sale is wanted.

Organisation.—In collaboration with the Rural Industries Intelligence Bureau the Trading Society aims at stimulating rural industries which can be carried on economically and profitably for the workers, and in the circumstances no industry will be recommended to any group of workers that cannot be carried on upon a commercial basis. The services of the Country Industries Co-operative Society, Ltd., would be available to:—

(*a*) All groups engaged in rural industries.

(*b*) Disabled ex-Service men's industrial settlements, centres, etc.

(*c*) Women's Institutes and Village Clubs.

(*d*) Existing home arts and industries associations.

(*e*) Independent rural industrial workers.

(*f*) Firms who are engaged in rural industries which it is the policy of the Society to encourage.

(*g*) Allied industries and craftworkers in the towns who make mechanical parts required for special rural industries.

(*h*) Landowners and farmers who produce raw material for special industries, such as osiers for basket-making.

The formation of County or local industries co-operative societies will form a necessary part in completing the scheme. Assistance will be given to those who want to form a county society, and the Secretary will be pleased to attend a meeting of the local committee in order to explain how a society is formed and worked. Model rules for the adoption of these societies have already been prepared.

In some instances, the production of a local industry is intended wholly for local requirements. An example of this is to be found in certain classes of basket-making, where both the raw materials and the market are found within a limited area. In such cases the County or local industries co-operative society

would be in a position to fulfil the functions of a trading agency, and after the local demand has been satisfied, the surplus could be disposed of through the Country Industries Co-operative Society Ltd., to which the local society will be affiliated.

Benefit to Agriculture.—The development of rural industries must prove to be a boon to agriculture, benefiting both the farmer and the agricultural worker. The latter, during the long winter evenings and also during severe weather, when he is prevented from working on the land, will be able to supplement his earnings by joining a group of village industry workers. This will tend to stem the tide of migration from the villages to the already overpopulated towns and will somewhat mitigate the labour problem of the farmer, while bringing prosperity to the rural districts.

Although the Society has only recently been established, considerable support has already been received from many associations throughout the country. This augurs well for its future success. In this connection it may be mentioned that 54 members of the Home Arts and Industries Association have promised to send all their products to the Society and also to purchase the raw material which they require; and that the Highland Home Industries Association, the Dorset Arts and Crafts Association, and the Wilts Arts and Crafts Association have also promised to dispose of their members' products through the Society. The National Federation of Women's Institutes, to which is affiliated over 2,400 Women's Institutes, propose to take advantage of the trading facilities of the Society.

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THE MIDDLE WHITE PIG.

SANDERS SPENCER.

MANY excuses have been offered for the alleged neglect in the past by the Royal Agricultural Society of the interests of the breeders of Middle White Pigs in not offering prizes for these animals when classes were instituted for Large and for Small Yorkshires, as the Middle Whites were as numerous and as distinct in character as either of the other two Yorkshire breeds. That their commercial value was far superior to that of pigs of the Small White breed has been amply proved, and their

present importance in the pig breeding world is perhaps quite equal to that of the Large White breed. Probably the omission for some years of a separate class for pigs of the Middle White breed was due to the fact that until the formation of the National Pig Breeders' Association some forty-seven years ago, to register the pedigrees of Small, Middle and Large Whites, Small Blacks, and Berkshires, which at that period were the only British breeds of pigs of any importance, there had not been any sufficient attempt made to keep the three first-named breeds distinct. In the minds of far too many people the Middle White pig was one which, mainly from its size, could not be classed as a Small or a Large White. For this error there was sufficient excuse, on account of the far too common system of intermixing the types and then selecting for exhibition in the different classes those pigs which at the time were considered the more nearly to comply with the regulation size and points of the particular breed for which the prizes were offered. The absence of a fair and sufficient representation of breeders of pigs on the Councils of the Royal Agricultural and other Societies has also been alleged to have been the principal cause of the admitted neglect of the pig, whose presence in the show yards was, in the past, looked upon as a necessary nuisance. The want of prescience on the part of those who formerly failed to encourage the exhibition of Middle White pigs has been most clearly proved at one or two of the recent shows of the Royal Agricultural Society, where the exhibits of Middle White pigs ranked with those of Berkshires and Large Whites, whilst two other breeds which in the eighties of the last century were considered to be worthy of separate classes, have both died natural deaths.

The extinction of the Small White and the Small Black breeds and the great improvement in pigs of the Berkshire breed during the past forty years have together proved that the breeders of pigs have given considerably more attention to the commercial points of the pig without seriously affecting its exhibition value. At the same time we are compelled to admit that there still exists room for improvement in the proportion of lean to fat meat, in the prolificacy of the sows and in their ability to rear large and vigorous litters of pigs. We do not mention these weaknesses as having special application to pigs of the Middle White breed, as the pork from them ranks high on the market, whilst the sows are specially noted for their marked ability to produce and to rear large litters of strong and healthy pigs.

These young pigs are also very hardy and good foragers, being particularly well suited for the open-air system of pig feeding, as the writer has proved during more than half a century. The Middle White, like the Berkshire, can be fattened at any age and furnishes pork of fine quality and flavour with a good proportion of lean to fat.

As the demand for small joints of meat is becoming more marked, boars of the Middle White breed are being extensively used for mating with the larger breeds of pigs, which have in far too many instances been bred with a view to the production of pigs of a size not demanded by the purveyor of pork nor by the consumer. Another objection which is made to the very large pigs is the far too great proportion of bone. This trouble is much reduced by the infusion of blood of the Middle White breed. The improvement thus made might probably be increased, rather than reduced, if the breeders of Middle White pigs were to pay rather more attention to the length of the bodies of their pigs and give less consideration to the very short heads and heavy forequarters. Length of carcass is not so much esteemed in the pork pigs as in the pig intended for conversion into bacon, but length of body is nevertheless demanded not only by the pork butcher but is a necessity to the breeding sow which is expected to rear large litters of pigs of a regular size. It has also been remarked that a sow with a long body usually possesses moderately light forequarters, and it may be equally true that thick shoulders and heavy forequarters are seldom associated with heavy milking qualities.

These critical remarks, from which the previous articles have not been free, may be taken as a proof that the perfect pig has not yet been evolved, but it is hoped that they will at least impress upon the breeders of all pedigree pigs the urgent necessity of giving every attention to the utility points of their respective breeds of pigs, and to the requirements of the consumer. The continued success of any breed of pig will depend to a very large extent on its supplying a commercial want.

The standard of excellence of the Middle White pig issued by the National Pig Breeders' Association is as follows:—

Colour.—White, free from black hairs or blue spots on the skin.

Head.—Moderately short, face dished, snout broad and turned up, jowl full, wide between ears.

Ears.—Fairly large, carried erect and fringed with fine hair.

Neck.—Medium length, proportionately full to the shoulders.

Chest.—Wide and deep.

Shoulders.—Level across the top, moderately wide, free from coarseness.

FIG. 1.—Middle White Boar.

FIG. 2.—Middle White Sow.

Legs.—Straight and well set, level with the outside of the body, with fine bone.
Pasterns.—Short and springy.
Feet.—Strong, even and wide.
Back.—Long, level and wide from neck to rump.
Loin.—Broad.
Tail.—Set high, moderately long but not coarse, with tassel of fine hair.
Sides.—Deep.
Ribs.—Well sprung.
Belly.—Full but not flabby, with straight underline.
Flank.—Thick and well let down.
Quarters.—Long and wide.
Hams.—Broad, full and deep to hocks.
Coat.—Long, fine and silky.
Action.—Firm and free.
Skin.—Fine and quite free from wrinkles.

Objections.—Black hairs, black or blue spots, a coarse mane, inbent knees, hollowness at back of shoulder, wrinkled skin.

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THE RHODODENDRON BUG.

(*Leptobyrsa* (*Stephanitis*) *rhododendri*, Horv.)

THE Rhododendron Bug is not a native of Great Britain and was first observed in this country in 1910, but it had probably been introduced some years earlier. It is now distributed throughout the rhododendron-growing districts of the southern and south-western counties and occurs in East Anglia. Although the country of origin is not definitely known the bug is present in many parts of the United States of America and it seems likely that it is a native of the Eastern States of North America, from which it has been distributed to Europe in the course of the trade in living plants.

The Rhododendron Bug is also known as the Rhododendron Fly and the Lace Fly, but the two last terms should be avoided, (1) because the insect is not a fly, and (2) because the true Lace Wing* is a most useful insect and so not to be confused with such a pest as is here described.

Plants Attacked and Nature of Damage.—The Rhododendron Bug is found upon rhododendrons and in the United States on species of *Kalmia*, the newer rhododendron hybrids being far more susceptible to damage than the long-established *Rhododendron ponticum*. The obvious signs of injury are the presence of chocolate-brown spots on the underside of the leaf and a pale

* See "Beneficial Insects," Ministry of Agriculture, price 4d., post free.

"freckling" on the upper surface (*see* Fig. 1). The bugs themselves live on the undersides of the leaves from which they suck the sap through minute punctures, each wound showing subsequently as a brown spot or scar. A brown gummy secretion is also often present owing to "bleeding" from the puncture holes. In mild cases the effect of the injury is to make the plant "unthrifty," the leaves being obviously unhealthy. In more severe cases the whole plant appears to wilt, and where the attack is combined with unfavourable weather conditions—as, for instance, a prolonged drought—death may occur.

Description and Life-History.—The appearance of the adult bug is shown by Fig. 2. The general colour is greyish-white, while the spaces between the veins on the wings are shining and transparent like glass. The body is black and for the most part hidden by the wings, which form a complete shield over the "back" and are probably not often used for flying. The bugs themselves are full-grown during July and may then be found living on the undersides of the rhododendron leaves. So sluggish are they that the leaves may be picked without causing them to move much or even attempt to fly.

After pairing the female lays her eggs within but at the side of the midrib of the leaf—also, though rarely, within the substance of the leaf itself. Several eggs are usually placed together, more or less in a line, but little can be seen of them, as they are almost wholly embedded in the rib, their position being marked by a scab of gummy secretion. The shape of the egg is shown by Fig. 3 and it will be noticed that only the tip of the egg reaches the surface. If the scab above mentioned be raised this tip can be seen as a minute ring—the "door" through which in due time the young bug will emerge. The bugs die by the end of the summer and the eggs remain through the winter and hatch early the following summer (perhaps late spring).

The young bug, when newly hatched, is a minute, rather spiny, black and grey insect, without wings, and about the size of a pin's head. As has been previously stated, it feeds by piercing the underside of the leaf with its "trunk" (proboscis) and by sucking up the sap. As it grows larger it moults and resembles Fig. 4, and after two further stages in which the developing wings can be seen, it casts its skin for the last time and becomes the fully winged adult bug.

At all stages the bugs are rather sluggish and tend to remain where they were hatched; in consequence the leaves of the previous seasons show the most damage. When the infestation is

FIG. 1.

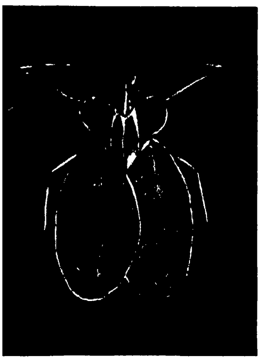

FIG. 2.

FIG 3.

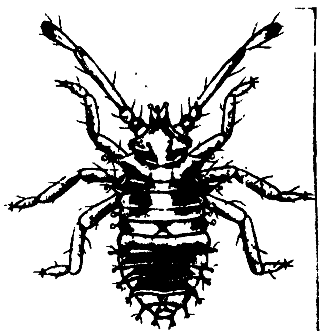

FIG. 4.

Rhododendron Bug.

FIG. 1—Infested cutting.
,, 2—Adult Bug.

FIG. 3—Eggs.
,, 4—Young Bug.

considerable and the old leaves are crowded with bugs, the latter seem to spread more readily to the new leaves and then these also show signs of injury. The eggs are laid both on the old leaves and on those of the current season, not exclusively on the latter as has been suggested by some writers.

The spread of the insects from one part of the country to another is almost certainly due to the distribution of infested plants, but in gardens the bugs presumably move from plant to plant even though they seldom seem to use their wings. Too much weight, however, must not be placed on the lack of records of the bugs being seen on the wing, for many usually sluggish insects fly freely under some special weather conditions which perhaps occur on one or two days only during the year.

Methods of Control.—1. *Spraying.*—In U.S.A. rhododendron bugs are killed by spraying them with such an insecticide as soap and water. The chief difficulty consists in wetting thoroughly the undersides of the leaves, which is absolutely essential if success is to be obtained. In the case of small plants and even large bushes, the difficulty can be overcome by the exercise of sufficient care on the part of those spraying, but it is almost insuperable where dense thick shrubberies are concerned unless they are of such value as to justify considerable expense. In spraying rhododendrons it is worth noting that the leaves are easily injured and the work should be done on dull days or in the evening.

A simple soap wash may be made by dissolving 1 lb. of good soft soap in 10 gallons of water. A nicotine wash is more effective and its use is certainly justified in the case of valuable plants or where an attempt is being made to eradicate the pest as opposed to preventing serious injury. It is made by adding 1 fluid oz. of 95-98 per cent. nicotine to each 10 gallons of the above soap wash. If soft water is available the soap may be reduced to ½ lb. to 10 gallons.

2. *Stripping and Hand-Picking.*—As the eggs are laid on the leaves it is clear that if the latter are all removed and burnt during winter the insects should be destroyed. It is not yet known how far this is a practical treatment but it may be mentioned that certain foreign countries appear to be adopting it in the case of rhododendrons for export. Hand-picking in summer is quite effective in the case of a few rhododendrons or at the first appearance of the bug in a previously uninfested garden. The signs of injury are so characteristic and obvious that it is not a difficult matter to remove and destroy infested leaves with the insects upon them.

Administrative Measures.—The Rhododendron bug is included amongst the pests scheduled under the Sale of Diseased Plants Order of 1921, and it is an offence against that Order to sell or offer for sale or cause to be sold or offered for sale any plant which is substantially attacked by Rhododendron Bug. The Order gives power to an Inspector of the Ministry to prevent the sale or movement of such a plant. Moreover, in order to guard against the further importation of this pest, Rhododendrons imported from abroad must be accompanied by a health certificate Diseases of Insects and Pests Order of 1921). The penalty on conviction for an offence against these Orders is a fine not exceeding ten pounds. Further information with regard to the Orders may be obtained on application to the Ministry.

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ANTHRACNOSE OF THE CUCUMBER UNDER GLASS.

II.

W. F. BEWLEY, D.Sc.,
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Control of the Disease.—(*a*) *Methods of Sanitation.*—Since it has been shown that *C. oligochaetum* may live from season to season in the rotten woodwork, paper packing, etc., of the houses, it is clear that special methods of winter cleansing must be employed after a season of disease, if the next crop is to be a healthy one.

Fumigation by burning sulphur has not proved efficient in the past and some new method must be sought. Experiments with an emulsion of cresylic acid and soft soap have shown that by thoroughly spraying the diseased woodwork of a house it is possible to destroy the infection. The emulsion is prepared in the following manner:—

> Pale straw-coloured cresylic acid (97-99 per cent. purity) and pure potash soft soap are placed in a bucket at the rate of 1 gallon of the former to 8 pounds of the latter and heated over a brisk fire until the soap is completely dissolved, the process taking about ten minutes to complete. This stock solution may be stored for future use, and the spray fluid is made by using one part of the stock to fifty parts of water.

To be completely efficient the diluted emulsion must be applied from a high-power spraying machine and should be carefully

directed on to every part of the structure, special attention being given to all parts of the woodwork that may be decaying. The ventilators should be left open while the spraying is in progress so that they may be thoroughly treated, but must be closed when the operation is complete, in order to retain the strong vapours. The hands of the operator should be protected by rubber gloves, and goggles worn as the liquid causes the eyes to smart.

The general method of cleansing cucumber houses after a diseased crop should be as follows :—

The plants and soil surface should be submitted to a light spraying with the diluted emulsion to destroy the infection present on the lesions, and then removed for burning. The old beds should next be moved, the houses tidied, and the borders forked, before thoroughly spraying in every nook and cranny with the diluted cresylic emulsion. A fortnight after this treatment the houses may be replanted, but as a final precaution every cavity in the woodwork should be filled with putty and painted over.

(*b*) *Spraying during the Growing Season.*—A great many different kinds of spray solutions have been tested upon this disease, and the most promising results have been obtained with liver of sulphur and lime-sulphur. A wide range of copper mixtures was tested and while the sprayed sections were cleaner than the controls, the fruits were badly spotted in some cases.

One essential quality of first class fruit is the presence of a perfect "bloom" on the surface, and consequently commercial growers hesitate to use any spray which destroys this "bloom" or spots the fruit.

Liver of sulphur and lime-sulphur have not been observed to damage the fruit. The foliage of the cucumber is difficult to wet thoroughly with ordinary aqueous solutions and the addition of an efficient "spreader" is necessary. Soap solution and saponin proved unsatisfactory in this respect, but both flour paste and casein were efficient. Flour paste is cheaper than casein and is therefore to be recommended. Different proportions of flour, liver of sulphur and water have been tested, and it was found that a solution containing 0.5 per cent. of flour and 0.4 per cent. of liver of sulphur was the most satisfactory. If the flour is reduced in amount, the wetting power is less satisfactory, and if the liver of sulphur is increased, a scorching of the young foliage results.

The following formulæ are recommended :—

5 lb. Flour.	1½ oz. Flour.
4 lb. Potassium Sulphide (Liver of sulphur).	1¼ oz. Potassium Sulphide.
100 gallons of water,	2 gallons of water.

To prepare two gallons of spray 1¼ oz. of liver of sulphur are dissolved in 14 pints of water in a bucket, while the flour paste is being made. A very little water (not more than 4 fluid oz.) is added to 1½ oz. of ordinary wheat flour and after the mixture has been rubbed down to smooth paste, 2 pints of water are added. The resulting mixture, which should be as thin as milk and quite as free from lumps, is then boiled, with constant stirring, until it froths up. It is then added to the liver of sulphur solution and mixed thoroughly, when the spray is ready for use.

The following lime-sulphur formulæ have also proved satisfactory :—

5 lb. Flour.	2 oz. Flour.
2 pints Lime-Sulphur (S.G. = 2.3).	1 fluid oz. Lime-Sulphur (S.G. = 1.3).
100 gallons of water.	2½ gallons of water.

Two and a half-gallons of spray are prepared as follows :—Two ounces of flour are mixed and boiled in 3 pints of water in the manner described above, and added to 17 pints of water in a bucket. One fluid ounce of lime-sulphur is then added and the whole thoroughly stirred.

The use of these sprays as a means of checking the spread of the fungus has been tested in commercial nurseries with satisfactory results. To be quite effective they should be used at the early stages of the disease, before the fungus has attacked the succulent leaf-stalk and stem tissues. Generally one or two plants are first attacked, and it is better to sacrifice these than to endanger the rest of the plants by allowing the diseased individuals to remain untreated.

When the disease first appears the plants should be thoroughly sprayed with either of the mixtures recommended, and on the next day every "spotted" leaf should be cut out and burned. This process of spraying and removing the diseased leaves should be repeated again at weekly intervals but generally two applications are enough if the fungus has not entered the petioles or stems. Spraying should be carried out only in the cool of the evening. The next morning the plants should be thoroughly sprayed with water to remove any surplus spray liquid that may have remained on the plants, and a little ventilation should be allowed. Care should be taken to see that the houses are well shaded, as after this treatment direct sunlight may give rise to scorching. The effect of the spray on cucumber plants is slight, if careful attention is given to the above precautions. Occasionally a newly opened leaf or tendril is burned, but rarely is there

any appreciable damage. If the fungus is allowed to get a strong hold upon the leaf-stalk or stem tissues, it is increasingly difficult permanently to check the disease. Its spread may be stopped for a time, but as only the spores and spore-bearing parts of the fungus on the outside of the plant are killed, the fungus within the stem grows out in time and produces masses of spores, which are rapidly carried about the house and the disease again appears. In these cases it is advisable to remove the diseased individuals and replant the house after thoroughly cleaning it.

The cleansing may be effected by means of the cresylic acid emulsion described, after which planting must be deferred for a fortnight; or else by a solution of liver of sulphur at the rate of 6 lb. in 100 gallons of water, or lime-sulphur at the rate of 3 pints per 100 gallons. When liver of sulphur or lime-sulphur is used, the house may be replanted in 24 hours.

(c) *Dusting.*—Dusting with sulphur powders has been extensively tested, but while it checks the rapid spread of the fungus. a complete control has never been observed.

(d) *Cultural Methods.*—Much can be done to prevent and control the disease by providing the best cultural conditions for the plants. The disease assumes its worst form and spreads most rapidly, when the atmosphere of the houses is badly ventilated and saturated with moisture, and also when there is a marked difference between the day and night temperatures in the houses. The conditions which best enable the plants to resist the disease may be summarised as follows:—

Plants should be grown steadily from the beginning, without any attempt at forcing, and a little air should be given whenever outside conditions will allow. The atmosphere of the houses should never be stagnant or saturated with moisture for long periods and efficient circulation of air should be encouraged by suitable ventilation. The beds should never be cold or sour, and careful attention should be paid to the maintenance of constant day and night temperatures.

Conclusions.—(1) *C. oligochaetum*, Cav., which causes Anthracnose of the cucumber, carries on a saprophytic existence in rotten woodwork, timber, paper, etc., in the glasshouses, and thus tides over the winter period.

(2) Straw manure from towns constitutes an important source of infection.

(3) Infected houses may be cleansed by spraying the interior woodwork during the winter with emulsified cresylic acid.

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(4) The disease may be controlled during the growing season by employing drastic methods of ventilation, or by alternately spraying the plants with liver of sulphur or lime-sulphur and flour paste, and removing the spotted leaves.

The author wishes to express his thanks to Dr. W. B. Brierley, of Rothamsted Experimental Station, for his kind criticisms and suggestions.

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NOTES ON FEEDING STUFFS FOR SEPTEMBER.

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Potatoes.—The price of potatoes has fallen to such an extent that in many cases the point will have been reached at which it is more economical to feed the potatoes to stock than to sell them in the open market and bring in other feeding stuffs. When rightly used, potatoes are a valuable feeding stuff for live stock. In the majority of cases they may be fed in the raw state without harm, but where facilities for steaming or cooking are available it is better to feed potatoes cooked or steamed. In feeding potatoes, care should be exercised to avoid "greening" since greened potatoes are not only distasteful to stock, but are also poisonous. Frosted or diseased potatoes should always be thoroughly cooked and the cooking water drained away before use.

Potatoes should always be fed mixed with a concentrated food. For pigs, a safe working rule is to allow 6 lb. of potatoes to every lb. of dry meal or concentrate. The potatoes should be thoroughly cooked in the smallest quantity of water that may be necessary, and the requisite amount of meal then added, the resultant mash being fed to the pigs. There is no need to attempt to remove the potato skins before feeding, even in the case of young pigs. Where, however, it is usual to remove the skins before feeding, this is easily effected by rubbing the cooked potatoes through a coarse wire sieve. The mash passes through and the skins are left on the sieve.

Quantities to use.—The practical objections to the use of potatoes for stock may generally be traced to wrong feeding methods. If potatoes are given in too large quantities, digestive disturbances are likely to arise. In feeding potatoes, therefore, the same method should be adopted as is used in the

DESCRIPTION.	Price per Qr. s.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv. s.	Price per lb. Starch Equiv. d.
Wheat, British	57/6	504	12 16	1 0	11 16	71·6	3/4	1·78
Barley, British Feeding	38/–	400	10 13	0 18	9 15	71	2/9	1·47
„ Canadian No. 4 Western	35/6	400	9 19	0 18	9 1	71	2/7	1·38
Oats, English White	39/–	336	13 0	0 19	12 1	59·5	4/1	2·19
„ „ Black & Grey	35/–	336	11 13	0 19	10 14	59·5	3/7	1·92
„ Scotch White	39/–	336	13 0	0 19	12 1	59·5	4/1	2·19
„ Chilian	38/6	320	9 19	0 19	9 0	59·5	3/0	1·61
„ Canadian No. 2 Western	32/–	320	11 4	0 19	10 5	59·5	3/5	1·83
„ „ No. 3 „	29/3	320	10 5	0 19	9 6	59·5	3/2	1·70
„ „ No. 2 Feed	28/6	320	9 19	0 19	9 0	59·5	3/0	1·61
„ American	27/–	320	9 9	0 19	8 10	59·5	2/10	1·52
„ Argentine	27/–	320	9 9	0 19	8 10	59·5	2/10	1·52
Maize, „	43/6	480	10 3	0 17	9 6	81	2/4	1·25
„ American	38/–	480	8 17	0 17	8 0	81	2/0	1·07
„ South African	38/9	480	9 1	0 17	8 4	81	2/0	1·07
Beans, Rangoon	8/–	112	8 0	1 15	6 5	67	1/10	0·98
Millers' offals—								
Bran, British	—	—	6 15	1 16	4 19	45	2/2	1·16
Broad Bran	—	—	8 5	1 16	6 9	45	2/10	1·52
Fine middlings (Imported)	—	—	9 10	1 7	8 3	72	2/3	1·20
Coarse middlings	—	—	9 5	1 7	7 18	64	2/6	1·34
Pollards (Imported)	—	—	7 2	1 15	5 7	60	1/9	0·94
Barley Meal	—	—	11 5	0 18	10 7	71	2/11	1·56
Maize „	—	—	9 15*	0 17	8 18	81	2/2	1·16
„ „ S. African	—	—	9 7	0 17	8 10	81	2/1	1·12
„ Germ Meal	—	—	9 12	1 5	8 7	85·3	1/11	1·03
„ Gluten-feed	—	—	9 5	1 11	7 14	75·6	2/0	1·07
Locust Bean Meal	—	—	9 5	0 9	8 16	71·4	2/6	1·34
Bean Meal	—	—	13 10	1 15	11 15	67	3/6	1·87
Fish „	—	—	15 0	5 10	9 10	53	3/7	1·92
Linseed Cake, English (9% oil)	—	—	13 2	2 6	10 16	74	2/11	1·56
Cottonseed „ English (5% oil)	—	—	8 2	2 6	5 16	42	2/9	1·47
„ „ Egyptian (5% oil)	—	—	8 0	2 6	5 14	42	2/9	1·47
Coconut Cake (6% oil)	—	—	10 15	1 19	8 16	73	2/5	1·29
Palm Kernel Cake (6% oil)	—	—	7 12*	1 9	6 3	75	1/8	0·89
„ „ „ Meal (2% oil)	—	—	6 5	1 9	4 16	71·3	1/4	0·71
Feeding Treacle	—	—	4 15	1 1	3 14	51	1/5	0·76
Brewers' grains, dried, ale	—	—	8 5	1 11	6 14	49	2/9	1·47
„ „ „ porter	—	—	7 7	1 11	5 16	49	2/4	1·25
„ „ wet, ale	—	—	1 4	0 8	0 16	15	1/1	0·58
„ „ wet, porter	—	—	1 0	0 8	0 12	15	–/10	0·45
Malt culms	—	—	8 7	2 3	6 4	43	2/11	1·56

* Prices at Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of July and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 9s. per ton. The food value per ton is therefore £8 11s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 3d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·2½d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

case of any feeding stuff newly introduced into the ration, *i.e.*, begin with small quantities and gradually increase until the total amount fixed upon is being consumed.

The maximum quantities of potatoes that it is advisable to feed have already been given in previous issues of these notes. They are 17 lb. per head per day for horses, and 28 lb. per head per day for fatting bullocks and cows. Pigs may be given cooked potatoes freely, but raw potatoes, if fed, must be fed cautiously.

Forage Crops for Winter Milk Production.—The increase in milk yield that results when the cows are turned out to grass in the spring is well known to all dairy farmers. In winter milk production, the cows are generally fed on roots, hay and straw chop, and concentrated cakes and meals. Where possible, the addition of a little green food daily will be found to be of value in keeping up the milk yield. For this purpose cabbage and marrow stemmed kale are two suitable crops to grow, and many dairy farmers make a practice of growing them for feeding to the cows during the winter months.

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Fruit Demonstration Plot, Wisbech.

THE Demonstration Fruit Plot which the County Council of the Isle of Ely established near Wisbech in 1920 has been partly planted with fruit trees. Several years must elapse before any definite conclusions can be drawn. The fruit trees which have been planted are mainly worked on the four outstanding types of the Malling stocks and the experiments have been designed to determine the particular stocks which give the best results in the Wisbech district. In addition, most of the newer varieties of dessert apples will be grown, and fruited quickly on very dwarfing stocks. Similarly designed experiments are in progress with pears and plums. Four of the locally popular varieties of apple have been planted to demonstrate methods of orchard arrangement suited to the district, and the trees will be used for pruning tests. There are variety trials of the soft fruits, Gooseberries, Black and Red Currants and Raspberries, in which some of the more recent varieties are included. A large strip of land is now being got ready for planting with Strawberries of several varieties, in the hope of discovering some newer sorts superior in merit to the local favourites:—Sir Joseph Paxton, The Laxton, and Royal Sovereign.

The Wisbech fruit growers have many problems needing investigation, relating to the proper manures for silt soil, and to the control of weevils, capsid bugs and other pests prevalent in the eastern counties, and they should derive much benefit from local experiments carried out on scientific lines.

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Conference on The World's Dairy Congress, 1923.

IN connection with the proposal emanating from the Dairy Industry in America to hold a World's Dairy Congress at Philadelphia in October, 1923, a Conference of representatives of the various branches of the Dairy Industry in this country was held on 28th July at the Ministry of Agriculture under the Chairmanship of Sir Francis Floud, K.C.B., Permanent Secretary.

The Conference was addressed by Professor H. E. Van Norman, President of the Congress, who placed before it the details of the proposal, emphasising the views of the promoters of the Congress that milk was an essential food for man and could, with great improvement in the health of most countries' population, be consumed in much greater quantity than at present. He pointed out that the Congress was intended to provide an international exchange for the most recent scientific knowledge and practice in regard to the dairy industry, to afford an opportunity for discussing the various systems of regulation and State control of the Industry, and to consider the influence of dairy products on national health and their vital importance to the development of the people. He stressed the need for increased co-operation amongst producers in improving the conditions of the industry, and generally discussed the benefits which were expected to flow from the holding of the Congress.

There were present representatives of the Royal Agricultural Society, the National Farmers' Union, the British Dairy Farmers' Association, the Agricultural Organisation Society, the Central Chamber of Agriculture, Milk Producers' Associations, Milk Distributors' Associations, the Milk Publicity Council and also representatives of some of the Overseas Dominions and of the various Government Departments interested. Manufacturers of milk products and dairy machinery and apparatus, breed and milk-recording societies, educational and scientific societies, and other bodies interested were also represented.

At the conclusion of the meeting, the following resolution was passed :—

> "That this meeting, having heard Professor Van Norman's statement of the objects, etc., of the World's Dairy Congress to be held in the United States of America in October, 1923, is of opinion that this country should be adequately represented at the Congress, and it requests the Ministry of Agriculture, in conjunction with the Ministry of Health, to invite the various associations and bodies interested in the Milk Industry to nominate representatives to serve on a General Committee to organise the representation of the Industry in England and Wales at the Congress."

A Committee on the lines indicated in this Resolution is now being formed.

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Shrinkage of Potatoes in Clamps.

DURING the last three years the Ministry has arranged for trials with potatoes to be carried out in several districts with the object of ascertaining the amount of shrinkage that takes place in the clamp, and the possibility of preventing the spread of disease in the clamps by treating in the following manner :—(1) spraying during growth, (2) sprinkling with quicklime when clamped, (3) sprinkling with sulphur when clamped.

It appeared in the earlier trials that the sulphur treatment checked the spread of disease in the clamps, but in 1921 no disease appeared in the haulm or tubers on any of the plots and no diseased tubers were found when the clamps were opened, so that verification of this could not be obtained.

As regards shrinkage, the average weight of potatoes put in each clamp on 16th September, 1921, was 2 cwt. 78 lb. On the opening of the clamps on 17th March, 1922, the average weight was 2 cwt. 28 lb., a shrinkage of 50 lb. or 16 per cent.

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Cow Insurance Clubs.

ONE of the best examples of a successful co-operative Cow Insurance Club for small farmers and small holders is at Moulton Chapel, near Spalding. The Moulton Chapel Cow Insurance Club has been run continuously for 98 years entirely by small cow-keepers living within a radius of a few miles of Moulton Chapel. The 24 simple "Rules and Regulations"

which have stood the test of experience were evidently drawn up by men of this class. There are no honorary subscribers.

The number of cows insured at the present time is 330. During last year the subscriptions received from members totalled £205 16s. 0d.; the amount paid for losses was £108; and the credit balance on the year's working amounted to £93 1s. 3d. The reserve fund is not allowed to accumulate to an undue extent; it now stands at £200 on mortgage and £153 at the bank. Last year was a good year for the society; on the other hand the previous year resulted in a loss on the year of £159 13s. 11d., the cow mortality being much above the average.

Owing to the increase in the value of cows, the cost of insuring a cow for one year has been increased from 6s. to 12s. Seventy-five per cent. only of the certified value of the cow is paid to the member; this is a sound rule as it tends to keep out undesirable animals, and negligence when a cow is ill is not encouraged. The important official of a society of this kind is the marker, who should be a good judge of cattle. In establishing a new society, payment of subscriptions in advance helps greatly until funds have been accumulated to withstand the drain of an abnormal season.

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Protection of Purchasers of Poultry Foods Under the Existing Law.

MANY complaints have been received by the Ministry as to the adulteration and misdescription of articles sold as food for poultry, and it has often appeared that poultry keepers are unaware of the steps which they can take under the existing law to protect themselves. The principal Act of Parliament bearing on the subject is the Fertilisers and Feeding Stuffs Act, 1906.

Section 1 (2) of this Act provides "that every person who sells for use as food for cattle or poultry any article which has been artificially prepared shall give to the purchaser an invoice stating the name of the article, and whether it has been prepared from one substance or seed or from more than one substance or seed, and in the case of any article artificially prepared otherwise than by being mixed, broken, ground, or chopped, what are the respective percentages (if any) of oil and albuminoids contained in the article, and the invoice shall have effect as a warranty by the seller as to the facts so stated, except that as respects percentages the invoice shall have effect

as a warranty only that the actual percentages do not differ from those stated in the invoice beyond the prescribed limits of error." It also provides that "any statement by the seller of the percentages of the chemical and other ingredients contained in any article sold for use as a fertiliser of the soil, or of the nutritive and other ingredients contained in any article sold for use as a food for cattle or poultry, made after the commencement of this Act in an invoice of such article, or in any circular or advertisement descriptive of such article, shall have effect as a warranty by the seller."

The seller is liable to be prosecuted for any of the following offences:—

(a) Failure without reasonable excuse to give on, or before, or as soon as possible after the delivery of the article, the invoice required by this Act, or

(b) Causing or permitting any invoice or description of the article sold by him to be false in any material particular to the prejudice of the purchaser; or

(c) Selling for use as food for cattle or poultry any article which contains any ingredient deleterious to cattle or poultry, or to which has been added any ingredient worthless for feeding purposes and not disclosed at the time of the sale.

Under this Act also, every County Council is required to appoint an Agricultural Analyst and one or more Official Samplers, The Councils of County Boroughs are empowered to make the same appointments, and many of them have done so. Such appointments are subject to approval by the Ministry.

In nearly every case, arrangements have been made for samples of poultry food to be analysed by the Agricultural Analyst at very low fees, and the advice and assistance of an Official Sampler can generally be obtained free of charge. Poultry-keepers should ascertain from the Clerk to the Council of the County or County Borough what arrangements are in operation in the district in which he is carrying on business.

The purchaser, therefore, of poultry food can in a great measure protect himself by requiring from the seller of the material he is purchasing, a definite description of the material and then submitting the article to the Agricultural Analyst for analysis. Care should be taken to ensure that any sample submitted is representative of the bulk, otherwise the results of the analysis may be misleading.

If the services of an Official Sampler can be secured, and the sample is taken in the prescribed manner by him, all question

as to whether the sample is representative of the bulk will be, as far as possible, avoided.

In cases where the seller refuses to give an invoice as required by the Act, the purchaser should communicate with the Official Sampler, who will generally deal with the matter under the Act.

The real significance of many of the terms used to describe poultry foods is very doubtful and buyers should endeavour to obtain a full description of the article, and should not be contented with the name only.

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The Purchase of Compound Manures.

MANY farmers are in the habit of purchasing compound or complete manures. This procedure certainly saves the trouble of mixing artificial manures on the farm. On the other hand different crops and different fields have different manurial requirements, and in each case a mixture of manurial ingredients in different proportions is likely to be required. Examples of mixtures suitable for different crops in various cases and hints on the mixing of manures are given in the Ministry's Leaflet No. 344.

No farmer should order a compound manure until he has obtained from the vendor and carefully studied an analysis of the manure in question. The agricultural value of a manure depends on the amount of plant food—nitrogen, phosphates and potash—which it contains, and on the form in which these three foods are offered to the crop.

Suppose a farmer is offered a ton of manure containing, say, 5 per cent. (or 1 cwt.) of nitrogen, 15 per cent. (or 3 cwt.) of soluble phosphates, 5 per cent. (or 1 cwt.) of insoluble phosphates, and $2\frac{1}{2}$ per cent. (or $\frac{1}{2}$ cwt.) of potash. What should he pay for it? Certainly little more than the sum at which he can purchase, and, if required, mix, artificials of recognised agricultural value containing the same amount of fertilising material. Now 20 cwt. of sulphate of ammonia contain roughly about 4 cwt. of nitrogen—therefore to get 1 cwt. of nitrogen, he must buy 5 cwt. sulphate of ammonia, costing to-day about £4. Again, 20 cwt. of superphosphate contain roughly about 7 cwt. of soluble phosphate—therefore to get 3 cwt. of soluble phosphate he will need to buy about 9 cwt. of superphosphate, costing to-day about £2 5s. Next, 20 cwt. of steamed bone flour contain roughly about 12 cwt. of insoluble phosphates—he will need, therefore, about $1\frac{2}{3}$ cwt. of this, costing, say, 13s. 4d. Finally, 20 cwt.

of kainit contain about 2½ cwt. of potash—he will need, therefore, 4 cwt. of kainit costing about 12s. Thus he can obtain standard manures of equal agricultural value to that offered for £7 10s. 4d. Put in another way the equivalents are: for every 1 per cent. of nitrogen offered, 1 cwt. of sulphate of ammonia; for every 1 per cent. soluble phosphates, ⅝ cwt. of superphosphate; for every 1 per cent. of insoluble phosphate, ⅓ cwt. of steamed bone flour; and for every 1 per cent. of potash, 1⅗ cwt. of kainit.

The above is a rough method only. A more accurate method is to find the unit values (*i.e.*, the value of 1 per cent. per ton, or 22.4 lb.) of nitrogen, soluble phosphates, insoluble phosphates and potash in standard manures (*e.g.*, sulphate of ammonia, superphosphate, steamed bone flour and kainit as above) multiply by the percentages of each in the compound manure and add the results, adding an allowance for cost of mixing. Taking as above, sulphate of ammonia (20 per cent. nitrogen) at £16 per ton, superphosphate (32 per cent. soluble phosphates) at £4 10s. per ton, steamed bone flour (60 per cent. total phosphates) at £8 per ton, and kainit (12½ per cent. potash) at £3 per ton, then the unit values are: nitrogen 16s.; soluble phosphate 2s. 10d.; insoluble phosphate 2s. 8d.; and potash 4s. 10d. A ton of a compound manure containing 5 per cent. of nitrogen, 15 per cent. of soluble phosphates, 5 per cent. of insoluble phosphates, and 2½ per cent. of potash, would be worth, therefore, 5 × 16s. *plus* 15 × 2s. 10d. *plus* 5 × 2s. 8d. *plus* 2½ × 4s. 10d. = £7 7s. 11d. per ton *plus* an allowance as explained above for mixing.

In working out unit prices in this way care must be taken to observe whether the prices on which calculations are based are prices delivered at the farm or nearest railway station, or prices at the works; if the latter, carriage of course must be added. The quantities (*e.g.*, 2 ton lots) to which the prices relate should also be noted, relatively more per unit will have to be paid for small than for large quantities.

The unit method of valuation also allows of the prices of standard manures being compared with one another. A full account of the method will be found in the Ministry's Leaflets Nos. 72 and 80. Unit values at London are regularly published in the Ministry's *Agricultural Market Report* (price 2d.) each week.

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Warmley and District Allotments: Village Co-operation in Gloucestershire.

A USEFUL example of the value of co-operation for small cultivators and poultry keepers is afforded by the Society known as The Warmley and District Allotments, Ltd. The Society was established in November, 1919, its original objects being to help members to obtain land for allotments, to arrange for lectures, and to obtain expert advice on gardening. The allotments have been obtained through the Parish Council and the lectures and advice have been given by the County Organiser and his staff.

The Society joined the Bristol and District Small Holdings and Allotments Federation, Ltd., and also became affiliated to the Agricultural Organisation Society. The Federation advised as to land suitable for allotments and in the first year provided seed potatoes through its system of collective purchase.

The Society started with 19 members and there are now 183. The subscription is one shilling per annum. Trading is done on a basis of 5 per cent. profit, and was started by buying seed potatoes with the object of securing reliable Scotch seed, true to type and at the lowest rates. The Bristol Federation booked the Society's order in November, 1919, which was fortunate, as in the spring of 1920 supplies were unobtainable and the first year's dealings with seed potatoes proved very successful, but the second year, however, the Society received a severe set-back: it purchased on its own account seed potatoes from Scotland in October when prices were high, the general belief being that, as in the previous year, supplies would not be obtainable later. There was a heavy drop in prices before delivery, and two tons of the seed potatoes proved to be diseased. There was a loss of £50 on this purchase, which was a very severe blow to this small Society.

After the first year's successful trading in potatoes, the poultry keepers urged the Society to supply them with food. In April, therefore, a start was made by buying meals and grains direct from the mills, and it was found that the members could be supplied at a saving of 10 per cent. on the prices then obtaining locally, though the local prices quickly dropped in sympathy. This brought in many new adherents to the Society, and the supply of foodstuffs is now the biggest part of its trade. The total turnover last year was £824 11s. 9d.

Courses of lectures are arranged to cover the winter months, and the County Instructors visit the members' gardens, allot-

ments, and poultry yards, during the spring and summer to give advice. During the first summer of its existence, the Society organised a small horticultural show.

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Agricultural Returns, England and Wales, 1922.

The preliminary tabulation of the Agricultural Returns collected on the 3rd June, 1922, in respect of agricultural holdings above one acre in England and Wales shows that the area under all crops and grass is 26,024,000 acres, or 120,000 acres less than last year. There is, however, an increase of 56,000 acres in the area returned as rough grazings, so that the reduction in the total acreage of land covered by these returns is about 64,000 acres. The cultivated area comprises 11,309,000 acres of arable land and 14,715,000 acres of permanent grass.

PRELIMINARY STATEMENT of Acreage under CROPS and GRASS in England and Wales on 3rd June, 1922.

DISTRIBUTION.	1922.	1921.	INCREASE.		DECREASE.	
	Acres.	*Acres.*	*Acres.*	*Per Cent.*	*Acres.*	*Per Cent.*
TOTAL ACREAGE under all CROPS and GRASS	26,024,000	26,144,000	—	—	120,000	*0·5*
*ROUGH GRAZINGS	4,762,000	4,706,000	56,000	*1·2*	—	—
ARABLE LAND	11,309,000	11,618,000	—	—	309,000	*2·7*
PERMANENT GRASS — For Hay ..	4,412,000	4,053,000	359,000	*8·9*	—	—
PERMANENT GRASS — Not for Hay ..	10,303,000	10,478,000	—	—	170,000	*1·6*
PERMANENT GRASS — TOTAL .	14,715,000	14,526,000	189,000	*1·3*	—	—
Wheat .. — Autumn Sown	1,933,000	1,911,000	22,000	*1·2*	—	—
Wheat .. — Spring Sown	36,000	65,000	—	—	29,000	*44·6*
Wheat .. — TOTAL	1,969,000	1,976,000	—	—	7,000	*0·4*
Barley	1,362,000	1,436,000	—	—	74,000	*5·2*
Oats	2,161,000	2,149,000	12,000	*0·6*	—	—
Mixed Corn	126,500	135,500	—	—	9,000	*6·6*
Rye	85,500	78,800	6,700	*8·5*	—	—
Beans	285,000	246,800	38,200	*15·5*	—	—
Peas	173,400	142,600	30,800	*21·6*	—	—
Potatoes	561,100	557,800	3,300	*0·6*	—	—
Turnips and Swedes	820,400	895,000	—	—	74,600	*8·4*
Mangold	422,600	374,800	47,800	*12·8*	—	—
Cabbage, Savoys and Kale	73,500	58,000	15,500	*26·7*	—	—
Kohl-rabi	16,400	9,900	6,500	*65·7*	—	—
Rape	74,900	82,000	—	—	7,100	*8·7*
Vetches or Tares	135,900	108,700	32,200	*31·1*	—	—
Lucerne	50,500	47,200	3,300	*7·0*	—	—
Mustard	39,500	45,200	—	—	5,700	*12·6*
Brussels Sprouts	15,100	12,500	2,600	*20·8*	—	—
Cauliflower or Broccoli	10,600	8,600	2,000	*23·3*	—	—
Carrots	14,100	8,200	5,900	*72·0*	—	—
Onions	3,600	2,900	700	*24·1*	—	—
Sugar Beet	8,400	8,300	100	*1·2*	—	—
Flax for Fibre	4,700	1,700	3,000	*176·5*	—	—
Linseed	4,800	6,100	—	—	1,300	*21·3*
Hops	26,300	25,100	1,200	*4·8*	—	—
Small Fruit	75,000	72,600	2,400	*3·3*	—	—
CLOVER and ROTATION GRASSES — For Hay ..	1,526,000	1,758,000	—	—	232,000	*13·2*
CLOVER and ROTATION GRASSES — Not for Hay	776,000	791,000	—	—	15,000	*1·9*
CLOVER and ROTATION GRASSES — TOTAL ..	2,302,000	2,549,000	—	—	247,000	*9·7*
BARE FALLOW	404,600	506,700	—	—	102,100	*20·1*

* Mountain, Heath, Moor, Down and other rough land used for grazing.

The arable area has been reduced by 309,000 acres, but it is still 311,000 acres greater than in 1914. In spite of this reduction the area under most crops is larger than last year, the decline in the total being more than accounted for by reductions in the area of clover and rotation grasses and bare fallow. As regards live stock the head of cattle has been increased, but the number both of sheep and pigs is less.

Cereals.—The area of wheat, 1,969,000 acres, is practically the same as in 1921, and some 233,000 acres greater than the pre-war average. Barley is being grown on an appreciably smaller area than last year, only 1,362,000 acres being under this crop against 1,436,000 acres in 1921. The acreage of oats is 2,161,000 acres, or 12,000 acres more than last year, and 98,000 acres more than the average of the ten years before the war. The total area under the three chief cereal crops (including mixed corn) is 5,618,000 acres, or 78,000 acres less than in 1921.

Beans and Peas.—The area of both beans and peas has been increased very appreciably, the former being grown on 285,000 acres against 246,800 acres last year, and the latter covering 173,400 acres, an increase of 30,800 acres.

Potatoes.—The very large area devoted to potatoes in 1921 has been fully maintained, 561,000 acres being under this crop. There is an increase in Lincoln and the north, the area being reduced in most other counties.

Roots.—The area returned as under turnips and swedes is 820,000 acres, or 74,600 acres less than last year, which was the lowest previously recorded. Since the date of the returns, however, a good deal of turnip sowing has been done on land which may have been returned as fallow in some cases. The mangold area has been largely increased, 422,600 acres being under this crop, against only 374,800 acres in 1921. The acreage of mangolds is the largest since 1914.

Other Crops.—Practically all other crops have been increased in area, only rape, mustard and linseed showing decreases. Among fodder crops, kohl-rabi and vetches in particular show large increases. All the vegetable crops have been much increased, the addition being very large in the case of carrots. Hops and small fruit have each been planted on additional areas, though in neither case is the rise nearly so great as in 1921. The large increase recorded last year in sugar beet has been maintained.

Clover and Rotation Grasses.—Owing to the failure of so many sowings last year, the area of clover and rotation grasses has been reduced by 247,000 acres to 2,302,000 acres. The reduction was much the heavier in the eastern half of the country, where the drought of last season was felt the more severely. The area reserved for hay is some 232,000 acres less than in 1921, but this is counterbalanced by an increase of 359,000 acres in the area of permanent grass for mowing.

Horses.—The number of horses on agricultural holdings has been reduced by 44,300 to 1,340,300. A further decline in breeding is to be noted, the number of foals being only 83,800 or 8,500 less than last year and 18,300 less than in 1914.

Cattle.—The total number of cattle, 5,721,800, is 205,000 greater than last year. Cows and heifers in milk or in calf number 2,521,400 or 20,000 more than in 1921, and the largest on record except in 1918 and 1919. The number of heifers in calf is, however, 74,300 less than the high figure of last year, but

is still some 17,000 greater than in 1920. The large increase in the number of calves recorded last year has practically been maintained, whilst the number of yearling cattle is 30 per cent. greater than in 1921. The heavy slaughtering of calves in the spring of 1920 shows this year in cattle two years old and above which number 78,300 less than last year.

PRELIMINARY STATEMENT of Numbers of LIVE STOCK in England and Wales on 3rd June, 1922.

	No.	*No.*	*No.*	*Per Cent.*	*No.*	*Per Cent.*
Horses used for Agricultural purposes (including Mares for Breeding)	804,700	822,700	—	—	18,000	*2·2*
Unbroken Horses (including Stallions) — One year and above	231.200	232,700	—	—	1,500	*0·6*
Unbroken Horses (including Stallions) — Under one year ..	83.800	92,300	—	—	8,500	*9·3*
Other Horses	220,600	236,900	—	—	16,300	*6·9*
TOTAL OF HORSES	1,340.300	1,384,600	—	—	44,300	*3·2*
Cows and Heifers in Milk	1 933.600	1,876,100	57,500	*3·1*	—	—
Cows in Calf, but not in Milk	288.600	251,800	36,800	*14·6*	—	—
Heifers in Calf	299,200	373,500	—	—	74.300	*19·9*
Other Cattle :—Two years and above ..	923,200	1,001.500	—	—	78,300	*7·8*
,, ,, One year and under two	1,166.600	893,500	273,100	*30·6*	—	—
,, ,, Under one year.. ..	1.110.600	1,120,300	—	—	9,700	*0·9*
TOTAL OF CATTLE	5.721.800	5,516,700	205,100	*3·7*	—	—
Ewes kept for Breeding..	5,424,400	5,336,500	87,900	*1·6*	—	—
Other Sheep :—One year and above ..	2,296.900	2,850,900	—	—	554,000	*19·4*
,, ,, Under one year	5,715,400	5,644,100	71,300	*1·3*	—	—
TOTAL OF SHEEP	13.436.700	13,831,500	—	—	394,800	*2·9*
Sows kept for Breeding	301,700	335,900	—	—	34,200	*10·2*
Other Pigs..	1.995.000	2,169,600	—	—	174,600	*8·0*
TOTAL OF PIGS	2.296,000	2,505,500	—	—	208,800	*8·3*

Sheep.—The shortage of keep last winter, which caused an early marketing of feeding sheep, coupled with the very high prices which have ruled for fat sheep during past months has resulted in a reduction in the number of sheep since last year, the total being 13,437,000 or 395,000 less than a year ago. The reduction is, however, confined to sheep other than ewes and lambs, the breeding flock having been again increased, though not to the same extent as last year.

Pigs.—The large increase in the number of pigs last year has not been maintained. The total, 2,296,700, is some 208,800 less than in 1921, but still over 300,000 more than in 1920, and, apart from last year, is the largest since 1915.

* * * * * *

Foot-and-Mouth Disease.—No outbreaks of foot-and-mouth disease have occurred since 30th June last, and all general restrictions on account of that disease have now been withdrawn. The dates on which the various districts under restriction on 30th June were freed, were *Derbyshire (Chesterfield)* area, 3rd July; *Northumberland* area, 22nd July; *Lancashire* and *Cheshire* areas, 23rd July; *Derbyshire (Bakewell)* area, 25th July; *West Lancashire (Poulton)* area, 25th July; *Birmingham* area, 25th July; *Berwickshire (Coldingham)* area, 1st August.

Berwickshire area was the last district subject to restriction imposed by the Foot-and-Mouth Disease (Great Britain) Orders. The maintenance of restrictions for such a prolonged period was necessary owing to the adoption of isolation in respect of certain outbreaks in that district.

ACREAGE OF HOPS.—Preliminary Statement compiled from the Returns collected on the 3rd June, 1922, showing the ACREAGE under **Hops** in each COUNTY of ENGLAND in which Hops were grown, with a COMPARATIVE STATEMENT for the years 1921 and 1920.

COUNTIES, &c.		1922.	1921.	1920.
		Acres.	*Acres.*	*Acres.*
KENT	East	4,010	4,010	3,260
	Mid	5,520	5,410	4,520
	Weald ...	7,110	6.630	5,710
	Total, Kent ...	16,640	16,060	13,490
HANTS		1,070	1,040	840
HEREFORD		3,950	3,520	2,990
SURREY		220	200	170
SUSSEX		2,330	2,270	1,790
WORCESTER		2,030	1,960	1,660
OTHER COUNTIES		90	90	60
TOTAL		26,330	25,130	21,000

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NOTICES OF BOOKS.

Agricultural Co-operation in England and Wales.—(W. H. Warman, with a Preface by Leslie Scott, K.C., M.P. London: Williams and Norgate. Price 5s. net.) It is a strange fact that persons who regard themselves as being practical and hard-headed and independent of theories are nearly always theory-ridden. The only difference is that the theories are theirs, of long and cherished establishment, and neither new nor derived from other people. There is an idea that the English farmer, even the most progressive of the class, is afraid or impatient of theories. Hence when Sir Leslie Scott wrote the Preface to this book, he was careful to insist that the practice of agricultural co-operation does not involve the acceptance of a social theory. Yet the practice of co-operation, in any industry, involves a theory of commerce; and the buying, selling and transport of goods constitutes a high proportion of a nation's economic activities. It is a striking commentary on the present economic organization, that the transport and distribution of goods require anything from a quarter to one-half the amount of labour that is required to produce them. This is the case even with farm produce. Indeed, in some individual cases, such as bread, there may be more labour used in the transport. manufacture and distribution of the finished article than in the production of the raw material. This is the reason why the form and condition of the organization for buying and selling farm produce is of such great importance to the farmer. The present organization for buying and selling is based on one theory, the co-operative organization is based on another, and even if these theories are unimportant to the English farmer, the result of the practices may mean the difference between profit and loss on the farm.

The value of theories, however, often depends upon the way in which they are established. The best are nearly always those which arise direct from the

consideration of the relevant facts, and if the theory arises from the facts without conscious search for it, its influence is greater than that of one for which there has been a conscious and logical process of seeking. This is the method pursued by Mr. Warman in his book. His intention was "to explain the aims and the ideas which animate co-operators as well as the facts of the present position," but he allows the aims and the ideas to emerge from the facts. For those who are afraid of theories, this book need hold no terrors. It is a plain unvarnished story, yet it has all the elements of sound material and thorough workmanship which should appeal to farmers if they are as practical minded as their friends think and declare them to be.

It is impossible to summarise the contents of a book so fitted with facts as this, for here are garnered as many facts as could be conveniently stored within the covers of any one book on the subject. If it contains little theory it also contains little history, for the story of the early agricultural co-operative movement in England is contained in about 18 pages. The greater part of the book is devoted to the recording of events and movements since 1913 and to the discussion of current problems. This means that it summarises the experiences of the movement within the memory of those who are now concerned in its welfare. It goes farther than this, however, for where problems have arisen for which no solution has appeared in this country, some of the experience and methods of other countries is given. Yet this book differs from all others on agricultural co-operation in its primarily English character and its insistence upon the importance of English experience.

Naturally the discussion of the problem of the Agricultural Wholesale Society receives a good deal of attention, and as it is difficult to deal adequately with the pros and cons of this subject, those interested should read with care Chapter V. The chapter on the Agricultural Organization Society seems scarcely adequate, but it was good policy to give the available space to the description and discussion of the work of the actual trading societies. The most interesting matter in the book is in Appendix A, which should not be overlooked by any reader. This summarises the experience of twenty years' work in a very brief and illuminating way. Here the main general principles which must govern every successful co-operative movement are laid bare, and again it should be clear that they have arisen directly from experience.

"As a mere business method" co-operation "has justified itself." Still "the avenues for co-operative developments are unlimited," only "each step forward has to be considered on its merits." As long as English agricultural co-operators look at their experience and aims in this way there is every prospect of the continued success of their movement. They need not be afraid of theories when they derive them from experience, even though the co-operative movements of other countries have developed theories and practices which would not be acceptable to English farmers of the present day. This is a thoroughly English book which should be read by all who are interested in agricultural trading, including even the many critics of the co-operative movement.

Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE,
By Metchim & Son, Princes Street, Westminster, S.W. 1.

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXIX. No. 7.

OCTOBER, 1922.

NOTES FOR THE MONTH.

Sir Arthur Boscawen and the Agricultural Situation.

SPEAKING at the Town Hall, Cowbridge, on 19th September, Sir Arthur Boscawen, Minister of Agriculture, said that agriculture was going through a very serious crisis. The temporary prosperity of the war period and the years immediately following the armistice had disappeared and the industry was suffering from one of those periods of acute depression which the history of British agriculture showed occurred from time to time. All industries were depressed to-day, but he thought agriculture was probably the most depressed of all industries. The present year had been particularly disastrous, the cold wet summer and the difficulty of harvesting the crops had greatly added to the difficulties of the farmer who had to contend with a further fall of prices, especially in respect of corn and potatoes. The fall in the latter was chiefly due to the collapse of the German exchange, which resulted in the Germans being unable to buy Dutch potatoes, as was the usual practice, and the Dutch potatoes were, therefore, dumped here. In addition, there was a large supply of home-grown early potatoes which was put on the market at the same time.

With regard to corn he had heard of very low prices being given for English wheat, and he was afraid that there was a great tendency among farmers to rush their wheat, much of which was in bad condition owing to the weather, on to the market. He quite understood that farmers were hard up and wanted ready money, but if they could only hold off for a time they would prevent prices being driven down to a disastrous level. When things went wrong in any industry now, it was customary to look to the Government for help. Farmers were no exception to this rule. As a matter of fact, Governments could do little to help trade and Government interference often

(45087). P.1./R.3. 10,500. 10/22. M. & S. A

did a great deal more harm than good. Although as Parliamentary Secretary to the Ministry he had piloted the Agriculture Act through the House of Commons, it was certain that the country, which was pre-eminently an industrial one, would not pay heavy subsidies to the agricultural interest, and indeed it could not afford to do so. He had come to the conclusion that to make agriculture a spoon-fed industry and to couple this with wholesale Government control and interference was the wrong way of proceeding.

Assistance must be given in other ways, and his idea was that they should look rather to an extension of credit facilities to enable permanent improvements to be carried out and to help farmers in the conduct of their business and also to lightening the crushing burden which fell on agricultural land. Something had been done this year by the change in the valuation for Income Tax, but more would have to be done. He was working himself on these lines, and he could assure agriculturists that they were not without sympathisers in the Government. It was recognised that the gradual destruction of country life and the drain of the rural population into the towns was a grave danger to the country. He should like to see a great extension of smallholdings, with easy facilities for the purchase of their holdings by their occupiers so as to build up a race of peasant proprietors. Smallholdings could often be made to pay when large farms would not.

One thing from which farmers and consumers alike were certainly suffering was the excessive profits made by middlemen. He had been preaching co-operation for years, but so far not with very great results. But what could be done when farmers acted together was shown by the recent agreement made with regard to milk prices, on which he congratulated the National Farmers' Union. Beyond all things co-operation and goodwill between landowners, farmers and labourers was essential. All were suffering alike now.

In this connection he called attention to the fact that most of the Conciliation Committees, which had been a great success up to date, would be revising their agreements in the next few weeks. When things went wrong and prices fell, the temptation to the farmer to make drastic cuts in wages, which represented nearly half his costs, was very great, but he hoped and indeed felt sure that notwithstanding their difficulties farmers would be reasonable and would not attempt to drive wages down below the subsistence level. If they did, they would entirely alienate public opinion, and there would be an instant

demand for the re-establishment of the Agricultural Wages Board, which, in his opinion, would do great harm to the industry.

Speaking of the Canadian cattle question, Sir Arthur said that he had always been opposed to a change in the wise policy adopted in 1896 for the protection of our flocks and herds. But he had been defeated in the House of Commons, and the House of Lords had also passed a modified resolution in favour of admitting them. He thought the best course for the agricultural community to take now was to accept the verdict, and to press for such regulations as would safeguard both the health and the purity of blood of our live stock, which was the finest in the world, and in respect of which we must not take any serious risks. At the same time, the regulations must not be such as to prevent trade, but he thought arrangements could be made under which no serious injury would ensue.

In conclusion, he urged his audience not to be too downhearted; agricultural prosperity would return.

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Conciliation Committees: Letter from the Minister of Agriculture.

THE Right Hon. Sir Arthur Boscawen, Minister of Agriculture, has sent the following letter, dated 7th September, 1922, to the chairmen, members and secretaries of Conciliation Committees:—

It is now twelve months since the Agricultural Conciliation Committees were established, and with the close of the first year's working I desire to express my thanks to the members and officers of the Committees for the public-spirited service which they have rendered to agriculture in carrying out their somewhat trying and invidious duties. The period when the Committees were established, coinciding as it did with heavy falls in the prices of farm produce, made the task exceptionally difficult, but the success which has attended the new system can be judged by the fact that out of sixty-one Committees which have been formed fifty-five have reached agreements during the year.

In many cases the current agreements are due to expire within the next few weeks, and I hope that both sides in considering new agreements will bear in mind the advantages of making them for reasonably long periods. When the Committees first started it was natural, especially in view of the uncertainty of the agricultural position at that time, that agreements should be made for short periods only. Subse-

quently, many Committees were able to reach agreements covering the whole summer, and it may well be that half-yearly agreements will become the rule in future. Frequent changes in wages are unsettling to both employers and workers, and a review of the position every half year affords a reasonable opportunity for either side to secure adjustments as it considers necessary.

It is gratifying to observe that many of the Committees have welcomed the presence of a representative of the Ministry at their meetings, and in this connection I have received many personal expressions of thanks from both sides. The responsibility for decisions as to wages rests, of course, solely with the Committees themselves, but, as in the case of similar bodies in other industries, the presence of a completely impartial person is often of assistance to both parties in the conduct of their negotiations, and needless to say I shall be glad to place the services of suitable officers at the disposal of the Committees when desired.

Whilst the number of agreements made during the past year is very satisfactory as showing that the idea of settling rates of wages by mutual agreement has been accepted by the majority of employers and workers, the effective test of the utility of the present system is the extent to which the wages agreements are observed. From such information as is at the disposal of my Department it appears that the agreements have been, with few exceptions, very well observed. The importance of avoiding even these few exceptions is obvious, and in cases where certain individuals persist in breaking away from the terms of a Committee's agreement, I suggest that the Committee should appoint a special Sub-committee to consider such cases and endeavour to bring the offenders into line. If such steps fail and non-observance of the agreement continues, the Committee should then, in the common interest both of employers and workers, consider the desirability of making the agreement binding by submitting it for confirmation.

The important point at the moment, however, is the settlement of wages for the coming winter, and I hope that the Committees will take up this question at an early date in a spirit of mutual goodwill which will lead to a successful conclusion.

A Review of the work of the Conciliation Committees during the past year appears on p. 648.

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International Labour Organisation and Agriculture.

ON 12th August last the Permanent Court of International Justice delivered its opinion on the question raised by the French Government as to whether the competence of the International Labour Organisation extends to the international regulation of the conditions of labour of persons employed in agriculture.

It will be remembered that the International Labour Organisation was established by the Peace Treaty to deal with labour conditions throughout the world, and in connection with the International Labour Conference held at Geneva in 1921 the right of the Organisation to deal with agriculture was disputed by the French Government. The question, which turned mainly on the interpretation of the Treaty, was referred to the Permanent Court of International Justice.

The Court after hearing evidence delivered a considered judgment in the course of which the meaning of the relative portions of the Treaty was fully discussed The conclusion finally reached by the Court was that "the competence of the International Labour Organisation does extend to international regulation of the conditions of labour of persons employed in agriculture, and it therefore answers in the affirmative the Question referred to it."

The following supplementary question was also considered:—"Does examination of proposals for the organisation and development of methods of agricultural production, and of other questions of a like character, fall within the competence of the International Labour Organisation?" This the Court answered in the negative, observing, however, that although the consideration of the means of production in itself would be alien to the functions of the International Labour Organisation, "it does not follow that the Organisation must totally exclude from its consideration the effect upon production of measures which it may seek to promote for the benefit of the workers," or that it should be "excluded from dealing with the matters specifically committed to it by the Treaty on the ground that this may involve in some aspects the consideration of the means or methods of production."

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Imperial Fruit Show, 1922.

AT no time was it more necessary for home producers to make great efforts to retain their position in the home markets, and this can best be done by grading and packing produce according to approved methods and presenting it on the market in the most attractive manner. Exhibitions of fruit which attract the general public have great usefulness in inducing increased consumption, and should afford the grower the opportunity to demonstrate the superiority of the home-grown article.

In so far as fruit and vegetables are concerned, an opportunity will be afforded for so doing at the Imperial Fruit Show, which the "Daily Mail" are organising to be held at the Crystal Palace from 27th October to 4th November, with the support, not only of this Ministry, but that of the Departments of Agriculture of Canada and South Africa, and also of the Fruit Trades Associations of these countries. The competition will not, as in 1921, be confined to apples, but will embrace most classes of fruit then in season, also tomatoes and potatoes. By such exhibitions the producers in the British Empire will have a unique opportunity of demonstrating the excellence of the fruit and vegetables grown within the Empire, while British growers, through competition, will profit much in the art of grading, packing and presentation.

At the previous Exhibition held in 1921, the home growers secured many of the premier prizes; and the exhibits generally showed that in the grading and packing of fruit progress was being made, yet the low marks awarded by Judges in many cases show that there is still room for improvement. After the Show each exhibitor was informed of the marks awarded by the Judge for his individual exhibits, and in the article on the Imperial Fruit Show of 1921, which will be found on page 659 of this *Journal*, the writers have dealt with the lessons to be learnt by a study of the Judges' score-card.

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Standardisation of Chip Baskets.

THE fruit-growing industry has suffered very many handicaps in past years, and not the least of these has been the chaotic condition of the various containers in which the produce is marketed. This has been especially the case with soft fruit such as strawberries.

The chip baskets in which this fruit is carried, although ostensibly of the same denomination, vary widely in their cubic

capacity, and growers are unable to know the exact weight of the fruit they are forwarding unless they weigh each individual basket. The retailer who buys these baskets in the market justly condemns those which are under-weight, and the loss is perforce borne by the grower, who has also to face the loss entailed by baskets in which over-weight is given.

It is satisfactory to note that all sections of the industry are becoming alive to these drawbacks, and that steps are being taken gradually to remedy matters. The first step was the formulation of the grading and packing scheme of the Federation of British Growers, which has led to the adoption of the British Standard boxes for apples. A second step was taken at the Imperial Fruit Show last year, when the question of the standardisation of chip baskets was discussed at a meeting of the basket manufacturers. The meeting decided that such standardisation was desirable, and as a result inspectors of the Ministry of Agriculture carried out investigations an account of which will be found in the article on page 605.

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The Agricultural Index Number.

INDEX numbers of prices of agricultural produce in England and Wales show that prices in August were on the whole lower than in July, the average increase in price compared with the corresponding month of the years 1911 to 1913 being 67 per cent. in August against 72 per cent. in July.

The following table shows the increase each month since the beginning of 1921, comparison in each case being made with the corresponding month in 1911 to 1913:—

Month.	*Percentage Increase in Prices.* 1921	1922
January	183	75
February	167	79
March	150	77
April	149	70
May	119	71
June	112	68
July	112	72
August	131	67
September	116	
October	86	
November	79	
December	76	

Most kinds of agricultural produce showed little change between July and August. Both wheat and oats declined in price

on the month, but as a decline is not unusual at the commencement of the cereal year, the actual comparison with pre-war years shows no change for wheat and a rise for oats. It should be noted that new corn did not reach the markets until late in August this year and the fall in prices is not fully reflected in the index figures.

Live stock generally are also practically unchanged, the downward movement of sheep prices having almost ceased during August. Milk shows a rise, but cheese and butter are little altered. Eggs show a fall, the rise in price from July to August being relatively less this year than in pre-war years, while a general reduction is recorded in poultry. Hay is decidedly dearer, and, following the steady advance which has been maintained since March, prices in August were over 50 per cent. above those ruling in August 1911 to 1913.

The chief cause of the decline in the general index number is the fall in value of fruit and vegetables, especially potatoes. Throughout the month potatoes declined and at the close were barely at their pre-war figure. Green vegetables also became much cheaper, while fruit, owing to the heavy crops of apples and plums, averaged only 10 per cent. above pre-war prices, as compared with a July figure of 155 per cent. for soft fruit.

The following table shows the average increases in value of the principal commodities since January:—

Percentage Increase as compared with the Average Prices ruling in the corresponding Months of 1911-13.

	Jan.	April.	May.	June.	July.	August.
Wheat ...	44	57	62	60	53	53
Barley ...	51	49	49	58	49	48
Oats	49	49	53	57	55	59
Fat cattle ...	62	65	70	71	70	70
Fat sheep ...	60	128	140	121	107	103
Fat pigs ..	71	90	91	82	91	92
Eggs ...	114	89	50	69	80	64
Poultry ...	76	83	110	116	103	85
Milk	125	42	27	28	53	70
Butter ...	46	49	54	59	79	77
Cheese ...	27	46	48	55	50	51
Potatoes ...	113	95	140	80	75	14
Hay	35	28	33	35	37	54

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THE BEGINNINGS OF FIELD DRAINAGE.

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FROM the earliest times when we have any definite information about agricultural practice in the island of Britain we learn that men were draining land which was otherwise unfit for pasture and tillage. The evidence for defensive works for low-lying land against the sea or river is much earlier than the evidence for field drainage. Even where there is no documentary evidence the dike and wall builders have left a monument behind them: and although we may dispute as to the age of the oldest dikes and walls at Romney Marsh or in Lincolnshire—and indeed archæology seems as yet to give no very certain answer—it is likely that the Romans saw them, it may be already there when they came, but at least constructed before Rome abandoned Britain to its fate. The contractor for inning marsh-land had already appeared in the thirteenth century*—he was not, as is very generally supposed, a discovery, under the title of *undertaker*, of Tudor England—and it is from the thirteenth century, so far as we are aware, that the first reference to field drainage in England occurs in the treatise written by Walter of Henley.† The drains Walter describes are water furrows for running off the surface water and he does not mention any other form of drain. Since, however, the Latin rustic authors were accessible throughout the Middle Ages, Palladius in particular appealing to the mediæval mind, the classical methods of open and covered drains must have been well known, even if, as is quite possible, the tradition had not passed on unbroken from generation to generation of farm labourers. Palladius appeared in an English dress early in the fifteenth century, and there is every reason to believe that the Chaucerian stanzas of the vernacular version describe, at least so far as draining is concerned, not only classical precept but mediæval practice as well: the farmer was told to make—

> "A furrow three feet deep thy landës thorough,
> With gravel or with little pebblë stonës
> Unto the midward filled."

If stones were lacking, "sarment," straw or lop would serve.‡

* *Assize Roll* No. 911, m. 7d.

† *Walter of Henley's Husbandry*, pp. 16, 17.

‡ *Palladius on Hosbondrie* (Early English Text Society), p. 150: sarment = Latin *sarmenta*, clippings from plants, especially vines.

At the end of the Middle Ages, Fitzherbert, who in this as in all other points describes mediæval practice, directs that if open drains "wylle not make the marres grounde drie, then you must make a soughe underneethe the erthe, as men do to get cole, yron, stone, leade or tynne."* This suggests that there had been a departure from the classical practice of cutting a channel and filling first with stones or brushwood and then with soil; and the method recommended by Fitzherbert was, there can be little doubt, that still practised in the seventeenth century in Staffordshire. "Mr. Sylvester, of Welford," we are told, "first digs a hole deep and large anough to receive a *Man* together with his instrument like a shovel, then he excavates the *hollow black earth* as far as his instrument will reach both ways, *i.e.*, about eight foot beside the diameter of the hole, leaving the upper turf thick above it; then at the same distance on a *line* from eight foot to eight foot, he makes other *holes*, and so still on as the work requires, and then putting in Alders . . . . or other fit materials, as *brush-wood* to keep the earth from falling in and choaking the *Sough*, it will drain the ground to that rate, that many times it will *sink a yard* or more."†

The classical practice was, however, that commonly followed in the seventeenth century. Walter Blith advocated drains three to four feet deep, filled first with faggots of willow, alder or lime, covered by turf and then with fifteen inches of stones, soil being placed on top:‡ this combines the two methods described by Palladius and other classical writers. There were other variations in detail: in Oxfordshire, for example, an "ingenious *Husbandman*, that having dug his trenches about a yard deep and two foot over, first laid at the bottom green *Black-thorn* bushes, and on them a *stratum* of large round stones, or at least such as would not lie close; and over them again, another *stratum* of *Black-thorn*, and upon them *straw* to keep the dirt from falling in between, and filling them up: by which means he kept his *trench* open, and procured so constant and durable a drain, that the *land* is since sunk a foot or eighteen inches, and become firm enough to support *carriages*."§

At the beginning of the eighteenth century there are notices of hollow brick drains as a substitute for drains of a classical model. A trench was cut and the bottom covered with bricks laid crosswise, other bricks being laid lengthwise at the sides

* *Boke of Surveyinge*, c. xxxiv.
† Robert Plot, *Natural History of Staffordshire* (1686), p. 356.
‡ *English Improver* (1649), pp. 23, 24.
§ Plot, *Natural History of Oxfordshire* (1676), p. 249.

and these covered again with another layer of bricks crosswise.* At that time also something very like the principle of the mole drain had been discovered—"the best and cheapest Method of draining Clayey Land" and one that "will do as well in Pasture, Arable or Wood Lands, as in Gardens." The operation is thus described by Stephen Switzer, its advocate: "Be provided then of three of four narrow Spades, about eight Inches wide and fifteen Inches long, with a Handle put into a Socket and Ring, with a Tread round it to set the Foot upon to dig, and at every twenty Foot asunder if the Ground lye near a Level (which is the worst Case that can attend this Method) dig a narrow Trench of about ten Inches or a Foot wide at most, quite through your Gardens at twenty foot asunder . . . . and a full Foot and half within the Clay: take a wooden Rowl of about five Inches Diameter at one End, of four Foot long and four Inches Diameter at the other; and placing this Rowl at the Bottom of your Trench, take the Clay you had before dug out, and with a Rammer ram it in round the Rowl, which will form a perfect Tube; and the Rowler being bigger at one end than the other, you may by the Help of a Chain fastened to the bigger End, pull it out of the Tube, so that proceeding at four Foot at a Time, you go through your whole Trench or Trenches from End to End, and all over your Garden; taking great Care to keep your Drains or Ditches on the Extremity of your Gardens, and at the End of the Tubes open.

"But this is not all, I should have premis'd that there should be a handle of about four Foot long, mortis'd into the great End of the Rowl, by which the Workmen shoggle about the Rowl, so as to loosen it in the Tube, by which Means the said Rowl will be the easier drawn out by the Chain aforesaid.

"I should have also set down, that before you move this Rowl you take a Puncher made in the form of a Pyramid a little broke off at the Top, about three Foot long, three Inches Diameter at the great End, and one at the small, with which Instrument (made of Wood as it is) you are to punch a Hole through the ramm'd Clay upon the Top of your Rowl, through which Perforation all the Water is to pass, that comes from the Ground above, down into the under-ground Drain or Tube below.

"And in order to keep this perforated Hole open, and not to be choaked up by the Earth's tumbling into it, you are to

* Stephen Switzer, *Practical Fruit Gardener* (1724), pp. 24, 25; A. Hunter, *Georgical Essays* (1770–72), III, 145 *ff.*

take some small Faggot-Wood or Furze-Bushes, and chopping them short, you are to cover the Hole therewith, adding at the Top a broad Tile to secure it from any Impression that may come from above." The result, says Switzer proudly, is that you have a "Field or Garden, as hollow and as unfit to retain stagnated Water as a Sieve." He claims that even in arable land he has known these "Tubes or underground Drains" to function after twelve years and that the cost was but about twenty shillings an acre, while where there was a gradient fewer drains would be required and the expense would be proportionately less.*

Switzer's method was not generally followed, but adaptations of it and methods embodying the same principle were practised in divers parts of the country, latterly under the name of plug draining.† The mole plough, which achieved the same result by drawing a cylindrical cartridge through the subsoil, appeared towards the end of the eighteenth century and there seem to have been a number of types all coming into use about the same time. Harry Watts was granted a patent in 1797 for such a plough: it was to be drawn by four or eight horses and was to be used in a water furrow or the bottom of a trench.‡ The practice of using the early mole ploughs to work in a furrow appears to have been general and the drains were cut to a depth of about 15 or 18 in. but occasionally less§: the work was heavy and teams of horses up to the number of fourteen or even twenty were employed.‖ The windlass system was introduced almost simultaneously: windlasses worked by eight men, sometimes by women, gave way to windlasses worked by horses.¶ The steam cable system which has now almost entirely superseded horse teams and windlasses did not make its appearance until the second half of the nineteenth century.

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* *Practical Fruit Gardener*, pp. 25 *ff.*

† W. Ellis, *Modern Husbandman* (1750), i, 109; *Modern Land Steward* (1801), p. 254; John Johnstone, *Account of Elkington's System* (1808), p. 166; *Third Report of Select Committee* (1836), p. 7; *Quarterly Journal of Agriculture*, iv, 501 *ff.*, and xi, 68 *ff.*

‡ *Patent Specification* No. 2195.

§ *Letters and Papers on Agriculture* (Bath and West of England Soc.), ix, 110; *Annals of Agriculture*, xxxvi, 399, and xliii, 486; *County Reports, Cambridgeshire*, p. 244.

‖ *Annals of Agriculture*, xxxvi, 399; *County Reports, Gloucestershire*, p. 260 *ff*, and *Cambridgeshire*, p. 244; *Quarterly Journal of Agriculture*, ix, 388; *R.A.S.E. Journal*, iv, 36.

¶ *Patent Specification* No. 2195; *Patent Specification* No. 2373; Richard Lumbert's Patent (1800); *Annals of Agriculture*, xlii, 413; *County Reports, Gloucestershire*, pp. 260 *ff*; *Quarterly Journal of Agriculture*, ix, 388; *R.A.S.E. Journal*, iv, 36.

While the mole plough was slowly evolving, inventors were experimenting with solid conduits which would replace the old stone and brushwood drains, and at the same time mechanical methods of cutting trenches were here and there introduced. Although the earthenware pipe was known in the seventeenth century it was used for conveying water supplies and not considered for a long time as a means of draining land.* Channels made of brick were in use, as we have seen, about the year 1700, and these in turn suggested bricks with a semi-circular cavity which might rest on the earth or on flat bricks or might be placed face to face to form a circular tube.† A brick arch a foot wide and an inch thick, in shape like a ridge tile, was used in Shropshire.‡ and there was a great variety of specially shaped bricks which, singly or in conjunction, would form conduits of divers geometrical forms.§ Circular earthenware pipes, however, were employed in Essex and elsewhere before the end of the eighteenth century, and although other shapes have from time to time been employed‖ (even so late as 1843 the Royal Agricultural Society awarded Silver Medals for oval, horseshoe and angular tiles)¶; the circular pattern was finally generally recognised as cheapest and most effective.

As an alternative to cutting drainage trenches by hand, heavy ploughs were employed in the eighteenth and early nineteenth centuries: teams of eight, twelve and even twenty horses are mentioned.** The general principle embodied in these ploughs was to set two coulters parallel at whatever width it was desired to make the trench, and to clear the spoil by two long mould boards, the share, of course, making a level sole. Trenches could be cut a foot deep and eighteen to twenty inches wide at the surface. Grey's draining plough was fitted with two land wheels to run on either side of the drain and to regulate the depth of the cut: this plough was fitted in addition with a centre coulter to loosen the earth.†† The Royal Society of Arts awarded premiums for ploughs of

* *Patent Specification* No. 11: John Etherington's Patent (1619); R. Bradley, *Weekly Miscellany for the Improvement of Husbandry*, No. 8 (1727).

† Johnstone, *Account of Elkington's System*, p. 159.

‡ *County Reports, Shropshire*, p. 17.

§ Lawson, *Farmer's Practical Instructor* (1826), p. 535, Fig. vii.

‖ *Quarterly Journal of Agriculture*, *N.S.* (1847–49), p. 372, and (1849–51), p. 563; *R.A.S.E. Journal*, iv, 369 *ff*; v, 273.

¶ *Ibid.*, iv, 371.

** Bradley, *Complete Body of Husbandry* (1727), pp. 33 *ff*; Ellis, *Chiltern and Vale Farming* (1733), p. 326; *Reports of H. of C. Select Committee* (1836), iii, 7.

†† Lawson, *Farmer's Practical Instructor*, pp. 97 *ff*.

this kind* and, among others, Arthur Young regarded their use with favour,† but in practice they seem to have shown no advantage over hand labour‡ and never came into general use. They fall properly into the category of contrivances "which have been invented but not found generally useful," as the *Farmer's Practical Instructor* has it,§ although of late years the essential principle has been revived in the Revolt Excavator which has achieved a very considerable measure of popularity in many countries.

The multitude of devices and inventions attested to the importance of drainage in the eyes of advanced agriculturists, but such drainage as was done for a long time followed on classical lines. It was not until the wave of improvements that set in with the repeal of the Corn Laws and the issue of public loans for drainage that modern methods became general. In 1826 mole draining was still uncommon. "The mole plough," it could be said, "is sometimes advantageously used in pleasure grounds, particularly such as have a declination of surface. It is also used with a good team to drain wet turnip land."‖ The application of steam was necessary before mole draining could become an easy and economical operation in those districts where it was most wanted. Tile draining remained hand work, and, although arduous, was not an over-costly operation: many mistakes, however, were made and large sums of money lost in laying tile drains too deep. Since that time, about the middle of last century, when, as Lord Ernle says, "drainage became the popular improvement," the practice has had its periods of eclipse and has risen and fallen in popularity with the prosperity of agriculture. Of recent years the lack of skilled men, high wages and the expense of tiles have combined to put a check on tile draining; and its costliness has deterred farmers in many districts from employing contractors for mole-draining, which, moreover, in most cases requires to be combined with main drains of tile. The introduction of the internal combustion engine has, however, introduced a new factor, and once again there are many

* Dossie, *Memoirs of Agriculture*, i, 79.

† *Farmer's Tour of England* (1771), i, 61; ii, 237, 483, 518 *ff.*

‡ *Ibid.*, iv, 473 *ff.* This appears to be Young's final opinion: his comments upon actual working experience as contrasted with "a committee experiment of one hour" are instructive.

§ p. 97.

‖ Lawson, *Farmer's Practical Instructor*, p. 98. Cf. W. Lester, *History of British Implements* (1804), pp. 186 *ff*; A. Gray, *Ploughwright's Assistant* (1808), pp. 137 *ff*; *Reports of H. of C. Select Committee* (1836), ii, 80, and iii, 6; *Quarterly Journal of Agriculture*, ix, 388 *ff*, and *N.S.* (1849–51), p. 562.

new ideas before the public aiming at reducing costs—mole ploughs, for example, of smaller bore than those usually employed, designed to be hauled by tractor, and machines of several types designed to cut trenches for tile drains.

The misfortune of draining operations in the past has been the lack of scientific knowledge of the relative efficiency of the different systems and methods offered to the farmer and the landowner. Tradition and unsupported theory have too often been accepted as gospel. It is now generally recognised as essential that a scientific system of field drainage must be based, like all other farming operations, upon observation and measurement, and that exact knowledge cannot be easily acquired. Already work has been started in several countries and before long it should be possible to prescribe with accuracy the best system of drainage in any given circumstance and to give a substantially accurate forecast of its economic results.

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THE AGRICULTURAL VALUE OF SEA-SAND.

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THE practice of applying sea-sand to the land is a very old one in Cornwall. The sand contains a large proportion of calcium carbonate from the shells of cockles, limpets, mussels and other varieties of shell-fish which are abundant on the coast.

Sources of the Sand.—In many places the beach is dry at low water for considerable distances seaward, and a fresh sea breeze will then carry the loose sand inland, and unless its progress is arrested by the cliff or running water it may spread over a large tract. The sand washed up during the period of spring tides may be blown away when left exposed during neap tides. In this way large areas, some of them several square miles in extent, have been covered by accumulations of sand in many districts along the coast, notably at Padstow, Perran Bay, St. Ives Bay and near the Land's End. The accumulations take the form of low hills and deep valleys or hollows, the hills or dunes being in many places 50 to 60 feet high from base to crest. Buildings have been buried and lost for ages until a removal of the sand by the wind or some other agent has again exposed them. As recently as in 1800 A.D. the sexton and worshippers

of Perranzabuloe regularly shovelled away the sand from the church doors on Sundays before they were able to enter the building.

At the present time the removal of the sand from one spot to another is almost entirely prevented by the growth of Marram Grass, Sand Reed or Sand Grass (*Psamma arenaria*, Beauv.), which almost entirely covers the dunes in all parts of the county. The first record of this plant in the county is given by Davey in his "Flora of Cornwall" as 1758 A.D., so that its introduction into Cornwall is comparatively recent.

The practice of carrying this sand for agricultural purposes is doubtless centuries old and enormous quantities were at one time being drawn annually. Probably its use was overdone in many places, for the idea that it was valueless was common in various districts a few years ago. During the last 20 years, however, it has been applied in increasing quantities and it has now entered into strong competition with burnt lime and ground limestone, proving in many localities to be the cheapest form of lime available to the farmer.

Application.—It is applied to the land in various ways, but, probably, most frequently as part of a compost or "mixed dressing." In the Penzance district the variety known as "lug sand" found at one part of the beach is carted to the farm and mixed with refuse from the broccoli crop, sea-weed, and farm-yard manure, the whole being allowed to rot down for a month or two, after which it is turned or dug over so as to mix the ingredients and then ploughed in for the potato crop. A somewhat similar plan is followed in other parts. Frequently the soil at the foot of the hedges (the so-called ditches) was at one time ploughed for three or four furrows wide and carted to some convenient spot in the field where it was mixed with sea-sand and dung. After being allowed to rest for a time it was dug over and mixed and then carted over the field. This plan was often adopted on temporary pastures before the cost of the labour involved made it more or less prohibitive. In other cases the sand is carted to the field and spread with long handled shovels from the cart as a dressing for grass. It is frequently used as litter either alone or in combination with straw (often from a mistaken idea of its value as an absorbent) and in this way finds its way to the manure heap and eventually to the soil.

The amount applied per acre varies widely, being larger near the coast. The average is from 4 to 6 tons per acre, but dressings of twice these weights are common.

Composition and Effects.—Its chemical effects on the soil would appear to be confined entirely to the action of the carbonate of lime which it contains in the form of powdered shell, for no other substance of agricultural importance can be found in appreciable quantity. It has been suggested that its value is due partially to the sodium chloride which it has retained from the sea water, but only the faintest traces of this substance can be found in sand taken direct from the beach, while in the bank or dune samples there would be even less.

In a series of carefully conducted tests carried out by one of the writers the following results were obtained:—

Situation.		*Percentage of sodium chloride in sand.*		*Amount of salt in a ton of sand as carted.*
Penzance lug sand (wet)	...	0·78	...	171 lb.
Porthtowan beach (damp)	...	0·19	...	4¼ lb.
Gwithian Bank (dry)	...	0·003	...	1 oz.
Bude Bank (dry)	...	0·008	...	2⅔ oz.
Harlyn Bank (dry)	...	0·002	...	⅔ oz.

Neither phosphates nor salts of potash or magnesia are present, none of these forming part of the material of the rocks and cliffs of this coast in determinable quantities. Samples of sand from most of the beaches around the coast have been tested by one of the writers and the proportion of carbonate of lime and the mechanical composition determined.

The table on p. 594 gives the percentage of carbonate of lime, its equivalent as lime (CaO), the amount of lime (CaO) in a ton of sand and the mechanical composition of samples around the coast of Cornwall from Bude to Plymouth.

This table shows that percentage of lime and mechanical composition have little connection or bearing on one another. One frequently hears it suggested that the fine sand is superior to the coarser in lime content; that blown sand is finer and therefore superior; that beach sand is better than bank, etc., but the table does not definitely bear out any of these contentions.

The cost to the farmer of the lime in the sand will depend almost solely upon the distance he has to cart it, the charge made for the sand when taken from the bank being merely a nominal one, while it may in most cases be taken from the beach free of cost. At the present time *burnt lime* is 43s. per ton at Truro delivered at the Railway Station, while *ground limestone* is 38s. per ton at the same place. As one ton of burnt lime is equal to 1¾ tons of ground limestone from the same quarry it is very evident that burnt lime is much the cheaper of the two.

Locality.	Chemical Composition.			Approx. value of Lime per ton of Sand at 2/- per cwt of Lime.	Mechanical Composition.		
	$CaCO_3$ % =	CaO %	CaO per ton of Sand.		*Fine.* —0·4 mm.	*Medium.* ·4 to ·6 mm.	*Coarse.* + 0·6 mm.
			cwt.	s. d.			
Bude	50·6	28·3	5·6	11 2	16·0	75·3	8·7
Polzeath	58·4	32·7	6·5	13 0	74·0	22·7	3·3
Padstow	73·4	41·1	8·2	16 5	12·5	63·1	24·4
Harlyn Bay	84·4	47·3	9·5	19 0	1·6	13·5	85·9
Mawgan Porth	55·9	31·3	6·2	12 5	45·5	53·1	1·4
St. Columb Porth	55·7	31·2	6·2	12 5	36·4	62·1	1·5
Perranporth (beach)...	49·2	27·5	5·5	11 0	10·4	74·1	15·5
Perranporth (bank)	52·5	29·4	5·9	11 9	47·3	51·8	0·9
Porthtowan	45·2	25·3	5·0	10 0	20·2	73·7	5·8
Gwithian	79·3	44·4	8·9	17 9	33·7	50·4	15·9
Connor Bar	74·5	41·7	8·3	16 7	27·5	54·3	18·2
Hayle	74·3	41·6	8·3	16 7	8·9	59·3	30·8
Lelant Ferry	59·3	33·2	6·6	13 2	23·7	69·2	7·1
St. Ives	68·0	38·0	7·6	15 2	—	—	—
Sennen	49·9	27·9	5·6	11 2	—	20·8	79·2
Porthcurnow	56·6	31·7	6·3	12 7	—	—	100·0
Penzance ("lug" sand)	13·8	7·7	1·5	3 0	95·9	3·0	0·7
Marazion ("lug" sand)	13·0	7·3	1·5	3 0	92·3	7·2	0·5
Porthleven	13·2	7·3	1·5	3 0	3·5	28·2	68·3
Gunwalloe	69·3	38·7	7·6	15 2	8·8	56·2	34·7
Helford River (estuary)	32·8	18·0	3·6	7 2	—	—	—
Maen Porth	33·5	18·7	3·7	7 5	14·6	24·0	61·4
Swanpool	13·6	7·6	1·5	3 0	23·6	20·6	55·8
Gyllyngvase (Falmouth)	43·9	24·5	4·9	9 9	3·9	21·6	74·5
Portscatho	45·7	25·6	5·2	10 5	12·6	30·3	57·1
Caerhayes	31·8	17·8	3·6	7 2	69·7	23·3	7·0
Gorran	21·6	12·1	2·4	4 9	4·0	49·2	46·8
Polkerris (Par)	13·5	7·5	1·5	3 0	4·2	26·3	69·5
Polmear (Par)	2·2	1·3	0·25	0 6	9·2	28·2	62·6
Looe (Front beach)	19·5	11·0	2·2	4 5	30·3	45·7	24·0
Looe (Sander's beach)	2·0	1·1	0·22	0 6	0·7	10·1	89·2
Rame (Whitsand Bay)	8·5	4·7	1·0	2 0	0·2	3·6	92·2

Shell-sand from Perranporth is being delivered on farms near Truro (a distance of 9 miles) at 6s. per ton, and as it contains nearly 6 cwt. of lime (CaO) to the ton of sand it makes the cost of the lime about £1 per ton on the farm. Sand from Padstow is being sent inland by rail and delivered at the railway stations at the following prices per ton:—Bodmin 9s. 8d., Otterham 8s. 6d., Launceston 10s., Camelford 8s. 2d., Liskeard 9s. 8d. This sand contains not less than 8 cwt. of lime per ton, so that the cost of the lime in it is not more than 25s. per ton at points so far distant from the source as Launceston and Liskeard. Ground limestone at these two places is at present somewhere about 35s. per ton and as this contains not more than 11 cwt. of lime (CaO) per ton of limestone the lime in it must be something like 63s. per ton. This certainly compares very unfavourably with the cost of the lime in the sea-sand, so that Cornish farmers would be well advised to ascertain the respective charges on the various forms of lime available—burnt lime, ground limestone and sea-sand. Taking a few of the most important centres in the county the prices may be compared as follows:—

	Per ton of Material.			*Per ton of Lime* (CaO) *in*		
	Burnt Lime, 95 % pure.	Ground Limestone, 95 % pure.	Sea-sand, 65–75 % $CaCO_3$.	Burnt Lime.	Limestone.	Sea-sand.
Penzance	45/-	40/-	5/-	47/4	75/2	12/-
Truro	43/-	38/-	6/-	45/3	71/5	20/-
Liskeard	40/-	35/-	9/8	42/-	65/9	23/6
Launceston	40/-	35/-	10/-	42/1	65/9	24/3

The excessive cost of the limestone is largely due to the fact that, unlike burnt lime, its railway freight does not come under the agricultural rate. Thus, while burnt lime at the kiln, Newton Abbot, is 30s. per ton, ground limestone is only about 17s. 6d. per ton, yet at Penzance, Truro, etc., the difference in price is only 5s. per ton.

This leads naturally to the question of the comparative manurial values of the three substances. In the first, burnt lime, we have the lime in what is considered its most active form, the oxide, while in the other two the lime is present as a carbonate. As far as the mechanical condition is concerned the ground limestone is much finer than the sea-sand and it would therefore be considered quicker in action and, possibly, of slightly greater value. Beyond this there seems to be no advantage in lime or limestone over sea-sand.

Action on Various Crops.—A good deal of information is available as to the action of sea-sand on various crops. Experiments have recently been carried out by the Cornwall County

Council to ascertain its effect on temporary pastures and its value when compared with burnt lime and ground limestone. On one farm the three forms of lime were applied in December, 1920, to old grass land, the pasture being thin and poor—little more than Yorkshire Fog and Crested Dogstail with diminutive leguminous plants. Phosphates. potash and sulphate of ammonia were sown across the limed plots. Within a year a very great improvement was noticed on all the plots, but of the three which had received some form of lime that to which sea-sand had been applied seemed in most respects the best and this superiority is still being maintained.

On another farm, at Roche, a field of 8 acres received a rather heavy application of superphosphate, bone meal and basic slag for rape in 1920. Dredge corn (a mixture of oats and barley) was next taken and grass and clover seeds sown with the corn. Neither artificial manure nor dung was used for this crop but on three plots, each one acre in area, some form of lime was applied, viz., No. 1, 4 tons of sea-sand; No. 2, 2 tons of ground limestone; No. 3, half a ton of ground lime. Six months after, when the first inspection was made, the "seeds" over the whole field were very thin and there was still a good deal of spurrey, sheep's sorrel, silverleaf and selfheal, but these weeds were less conspicuous on the ground lime and the limestone plots than on the sea-sand plot. The unlimed part of the field showed a much larger proportion still of weeds, silverleaf being particularly abundant. Twelve months after (June, 1922), a most remarkable improvement was seen. On each of the three plots to which lime had been applied there was a very dense growth of clovers (red, alsike, and white) and grasses, the former being then fully a foot high. The whole was so dense that it was only by separating it and thus getting to the bottom that any weeds could be found and they were then seen to be diminutive and weak. On that part which had received no lime there was an abundance of sheep's sorrel—the most conspicuous weed—silverleaf, and spurrey, with a very thin covering of grass and clovers, the latter evidently badly nourished.

The differences in the appearance of the two portions of the field were very striking, and could be plainly seen at a distance of two miles! Of the three limed plots the herbage of that which had received sea-sand was quite equal in every way (in some respects rather superior) to that of the other two.

The cost of the lime applied was as follows :—

No. 1. Four tons of sea-sand at 8/-	= £1	12	0
No. 2. Two tons of ground limestone at 35/- ...	= £3	10	0
No. 3. Half a ton of ground lime at 66/-... ...	= £1	13	0

These prices include in the case of the sea-sand carriage to the farm-yard, but with the lime and limestone, carriage to the nearest railway station. Although the cost of the sea-sand and that of the ground lime are almost identical it must be remembered that equivalent amounts were not used and that the effect of 4 tons of sea-sand may reasonably be expected to outlast that of 10 cwt. of ground lime: in fact appearances seem to indicate already that this is so.

Farmers' Opinions.—The testimony of farmers in all parts of the county as to the value of sea-sand is available and the opinions of a few may be given. A dairy farmer near St. Ives, writing on 17th June of this year, says, "We have 3½ acres of hay ('seeds') of which we manured 3 acres with 7½ cwt. of superphosphate mixed with an equal quantity of sea-sand and we have the finest crop I have seen in this district. The ½ acre left had better treatment previously, but one could tell to a foot where the mixture of sand and superphosphate went." A farmer with a good soil near St. Columb writes: "Sea-sand is being used more freely now than 20 years ago. It is applied at the rate of 4 to 10 tons per acre with artificial manures for turnips and wheat. On land which has been 'sanded' there is usually a better growth of clover, and cattle graze more closely. I applied eight loads per acre on permanent pasture in December, 1920, on a portion of a field. There was no appreciable difference in 1921 but in 1922 cattle showed a preference for the sanded portion and are grazing it more closely. The cost is from 4s. to 5s. per cart-load here, brought by traction engine with two trucks carrying about 16 tons."

Farmers who are living near the coast are generally alive to the value of sea-sand. Some, indeed, have used it to excess, but those who live 8 or 10 miles or more from the sea, consider the cost of the labour entailed in carting prohibitive. The latter should remember that the greater the distance the more valuable, generally speaking, this material is, as the land has already received sea-sand in inverse proportion to the miles to be carried.

Most farmers have observed the injurious effect of sea-sand on the oat crop, especially on granite soils, and several state that when "dredge corn" is sown after an application of sea-sand the resulting crop is mainly barley and on the spots where the heaps of sand stood there is frequently no oats at all. This result is doubtless due to the effect of the lime in the sea-sand, for similar effects are seen after the use of burnt lime, although

the majority of farmers believe the sea-sand is more injurious than other forms of lime and the ill effects more lasting. If this is so it is probably because of the large quantities of sea-sand applied.

Mr. Roberts of Ruthern, Wadebridge, sends the following statement with regard to the action of sea-sand on oats, barley and clovers:—

EFFECT OF SEA-SAND.

Field of 14 acres reclaimed from heather, etc.

2 acres.	5 acres.	7 acres.
Broken in 1908 from heath, etc.	*12 acres broken 1914 from heath.*	
1915. Oats.	1915. Oats, good crop.	1915. Oats, good crop.
1916. Oats.	1916. Oats, heavy crop.	1916. Oats, heavy crop.
1917. Oats.	1917. Oats, heavy crop.	1917. Oats, heavy crop.
1918. Oats.	1918. Potatoes, fair crop. No sea-sand applied.	1918. Rape, 5 tons sea-sand per acre. Good crop.
1919. Turnips, with 5 tons sea-sand per acre.	1919. Oats, fair crop.	1919. Oats, fair crop.
1920. White Oats.	1920. Oats, good crop.	1920. Oats, good crop.
1921. Oats and Barley, with "seeds."	1921. Oats and Barley, with grass and clover seeds.	1921. Oats and Barley, with grass and clover seeds.
No oats. Good barley and clover.	No barley or clover grew. A fair crop of oats.	A fair crop of barley and oats with good clover.

"On the 2-acre piece and the 7-acre piece there is now plenty of clover; on the middle piece (5 acres, no sea-sand) there is absolutely no clover although the mixture of seeds was the same as on the other parts and was drilled across the whole 14 acres."

Although lime has been proved to be injurious to the mangold crop in many places only one farmer out of several interviewed had observed any ill effects from the use of sea-sand. This farmer, a careful observer and recorder of facts, says, "when heavy dressings are applied oats fail and mangolds go off yellow with little leaf. Personally I think this might be counteracted by ploughing deeper and applying some clay and potash. Although the oat crop fails the sea-sand is of great value to the grass, and seeing that dairying is the chief asset the failure of the oat crop once in 10 or 20 years ought not to weigh very much against it." One farmer states that he gets a fine sample of oats from the use of sea-sand.

Nearly everyone has something to say concerning the favourable action of sea-sand on the clovers. Thus one farmer living near Truro says: "I have a field of 3 acres which was sanded 7 years ago, except a small part. The sanded part is now a mass of red clover; the remainder nothing but ryegrass and sorrel." As the red and alsike clovers usually die out in the

second or third year of the life of the pasture a more frequent use of sea-sand (or other form of lime) is desirable. In one district (Roche) where the results of applying sea-sand to a temporary pasture have been particularly striking, there has been a very great increase in the amount carted during the past season.

Of the mechanical effect of the sea-sand one need say but little, as the majority of the soils on the north side of the county watershed are on the light side and consequently the texture is not improved by the addition of such coarse material. In connection with this one must remember the heavy rainfall of the county, averaging not less than 40 in.

The importance of sea-sand to the Cornish farmer lies in the fact that the county is destitute of limestone except for one or two very small patches—remnants perhaps of the bed of White Chalk which probably covered a large part of the county at one time. The soils of the county are generally acid, being very deficient in carbonate of lime, and the whole of the burnt lime and limestone used on the land has to be brought by rail from South Devon or Somerset. The cost of the burning and subsequent carriage makes it very expensive, and thus enhances the value of the sea-sand.

Immense quantities of blown sand are found on many parts of the coast-line of England, as North Devon, Pembroke, Glamorgan, Anglesey, Lancashire, Lincolnshire, Norfolk, Suffolk, etc., and it would, at least, be interesting to compare the composition of some of these with that of the North coast of Cornwall and to ascertain what use, if any, is being made of the sand agriculturally. Such an exchange of ideas and facts could not but be beneficial to all concerned.

* * * * * *

FIELD EXPERIMENTS WITH ROCK PHOSPHATES AND BASIC SLAGS.

II.—EFFECT ON THE QUALITY OF HAY AND PASTURE.

G. S. ROBERTSON, D.Sc., F.I.C.

For the first part of this article see the JOURNAL *for September, p.* 519.

THE most important indirect effect of the application of basic slag to pasture is the great improvement which is brought about in the quality of the hay crop and the feeding value of the pasture. In other words one ton of hay from a slagged plot has a higher feeding value than one ton of hay from an untreated plot, and the feeding value of the herbage on a slagged pasture plot has a considerably higher value than the same weight from a corresponding untreated plot. The Cockle Park experiments have put the increased feeding value in the case of hay from the basic slag plot at 13s. per ton—a figure based on actual feeding trials and on pre-war values.

It is of considerable importance, therefore, when considering the value of the various substitutes for the rapidly disappearing high grade slag to which the Cockle Park results apply, to take into consideration their effect upon the quality of the hay crop and the pasture herbage. In other words, is the increased crop produced from rock phosphates and the new types of slag accompanied by a corresponding improvement in the quality and feeding value?

With this object in view samples of hay were taken for two seasons at each of the Essex Experimental Stations and a botanical analysis of the crop made. The results from two of the experimental centres which are typical of the results obtained at the other centres are dealt with below.

Martins Hoarne.—During the two seasons (1917 and 1918) following the application of the various phosphates the growth of red and white clover rapidly spread over the treated plots until in 1918 it was to the eye the dominant constituent of the herbage. As far as the eye could judge the advantage in this respect was with the high soluble slag in 1917 and with the rock phosphates, and particularly Gafsa rock phosphate, during the 1918 season (see Fig. 3). During the dry season of 1919 the clover on the phosphate plots as well as on the untreated failed to make an appearance. The phosphate plots were nevertheless always dis-

tinguishable from the untreated by their brighter and healthier colour and by the double crop of hay which they carried. Samples of hay were collected from each plot, and the results are set out in Table 1 and illustrated Fig. 6.

TABLE 1.—BOTANICAL COMPOSITION OF THE HAY BY WEIGHT AT MARTINS HEARNE FARM.

Soil: Boulder Clay. Manures sown: 28th February, 1917. Sample taken: 9th July, 1919.

—	Plot 1. Open Hearth (Fluor-spar) Basic Slag.	Plot 2. Open Hearth High Sol. Basic Slag.	Plot 3. No Manure.	Plot 4. Gafsa Rock Phos-phate.	Plot 5. Egyptian Rock Phos-phate.	Plot 6. Algerian Rock Phos-phate.
	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.
Clovers	trace	trace	trace	trace	trace	trace
Grasses	85·2	88·1	58·5	82·6	96·7	95·8
Weeds	14·8	11·9	41·5	17·4	3·3	4·2
COMPOSITION OF THE GRASSES BY WEIGHT.						
Lolium perenne ...	9·9	22·0	6·8	26·9	19·8	17·0
Phleum pratense ...	6·0	7·7	2·8	4·5	5·7	1·9
Cynosurus crystatus ...	20·6	14·7	10·8	25·2	28·7	10·6
Poa trivialis	1·3	12·0	0·6	10·9	7·3	9·5
Avena flavescens ...	1·3	1·4	0·6	1·0	1·3	0·6
Festuca ovina	—	0·9	—	—	—	—
Holcus lanatus	32·5	29·7	44·3	18·0	17·0	29·0
Agrostis alba	0·7	2·6	6·8	4·5	4·8	11·2
Anthoxanthum odoratum	27·7	9·0	27·3	9·0	15·4	20·2
	100·0	100·0	100·0	100·0	100·0	100·0
Superior grasses ...	39·1	58·7	21·6	68·5	62·8	39·6
Inferior grasses... ...	60·9	41·3	78·4	31·5	37·2	60·4

It is evident from the results that the action of the various phosphates has not been confined to the clover. They have had a very marked effect on the development of the grasses. The extent of the action is best shown by grouping the grasses into good or superior grasses and bad or inferior grasses, including in the latter category Yorkshire Fog (*Holcus lanatus*), Bent Grass (*Agrostis alba*) and Sweet Vernal Grass (*Anthoxanthun odoratum*). It will be seen from Table 1 and Fig. 6 that the High Soluble Slag, Gafsa rock phosphate, and Egyptian phosphate have given precisely similar results. Algerian phosphate does not seem to have been quite so good as the others, whilst the open hearth low soluble fluorspar slag, although it has produced a marked improvement, is nevertheless not so effective as the other phosphates.

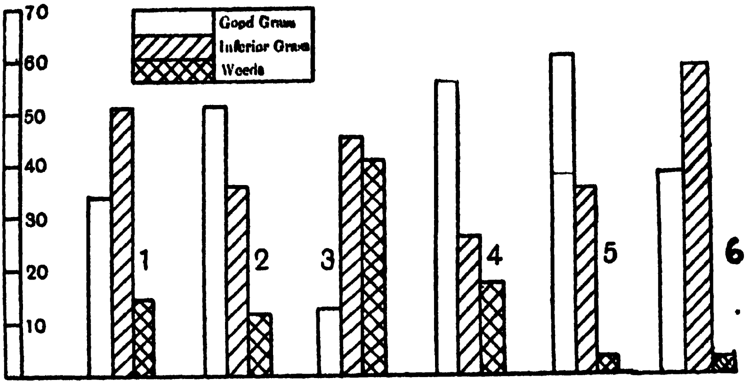

FIG. 6.—Botanical Composition of Hay by weight at Martin's Hearne, 1919.

1. Open hearth (fluorspar basic slag. 2. Open hearth (high soluble) basic slag. 3. Untreated. 4. Gafsa rock phosphate. 5. Egyptain rock phosphate. 6. Algerian rock phosphate.

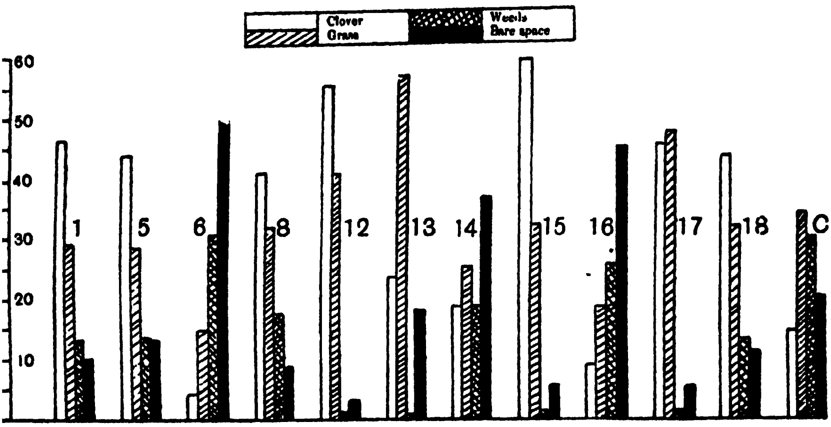

FIG. 7.—Percentage of Ground Space occupied by the Vegetation at Horndon, August, 1919.

1. Florida pebble phosphate. 5. Open hearth (high soluble) basic slag. 6. Untreated. 8. Gafsa phosphate. 12. Egyptian phosphate. 13. Superphosphate, heavy dressing. 14. Superphosphate, light dressing. 15. Superphospate and lime. 16. Untreated. 17. Open hearth (high soluble) basic slag. 18. Open hearth (fluorspar) basic slag. C. Lime.

During the more favourable season of 1920 clover again made good growth on the phosphate plots and bulked largely in the hay crop. There was quite as much present on the rock phosphate plots as on the high soluble slag plot. Only a partial analysis of the hay from three of the plots was made. The figures are given in Table 2.

TABLE 2.—BOTANICAL COMPOSITION OF THE HAY BY WEIGHT AT MARTINS HEARNE.

Sample taken: 9th August, 1920.

	Plot 2. Basic Slag. High Soluble.	Plot 3. Untreated.	Plot 4. Gafsa Rock Phosphate.
	per cent.	per cent.	per cent.
Clover	27·5	11·2	35·0
Grasses	63·0	58·5	54·2
Weeds	9·5	30·3	10·8

Horndon.—Samples of hay from the plots at this centre were taken in 1920 and a partial analysis was made.

It was quite evident from the figures that the various basic slags and rock phosphates bring about the same type of improvement, and there is nothing to choose between them in their effectiveness in this respect. It is thus reasonable to assume that the quality or feeding value of the hay produced from each must be similar.

Effect of Various Phosphates on the Pasture Herbage.—It is not possible at Horndon to cut the plots for hay in successive years. It is essential to alternate with grazing in order to establish a close bottom which will in the succeeding year, when the meadow is reserved for hay, protect the surface from the direct rays of the sun, keep the soil cool and thereby retain moisture and so enable the crop to grow. During 1919 the plots at Horndon were grazed by cattle and sheep. The contrast between the various plots was so striking that at the suggestion of Sir John Russell an endeavour was made to determine the percentage of the ground space occupied by the various species. In making the determination the method recommended by Armstrong* was followed. The results are set out in Table 3 and illustrated in Fig. 7.

Four interesting points emerge from the results:—

(1) The various basic phosphates, whether rock phosphates, high or low soluble slags, or basic superphosphate (superphosphate and lime), bring about exactly the same type of improvement in the pasture and they are equally effective in this respect.

(2) It is quite evident, if the results in Table 3 are compared with the weights of hay in the same plots in the succeeding year, that it is impossible to judge of the relative value of the various phosphates as regards yields of hay by an inspection of

* *Journal of Agricultural Science*, Vol. II, p. 283.

the pasture. A very effective illustration of this point is given by a comparison of Plots 17 and 18. As far as quality goes they are identical and examined in the grazed condition there is little to choose between them. When, however, the plots were reserved for hay and the crop weighed, Plot 17 produced a crop of 28.8 cwt. per acre and Plot 18, 16.8 cwt.

(3) The reason for the less satisfactory results from superphosphate on pastures where the chalk reserve is low or absent is apparent. Superphosphate alone (Plot 13) does not stimulate the growth of clovers to the same extent as the basic phosphates—it tells mostly on the grasses. Where lime is present or is added as on Plot 15, producing a " basic superphosphate," the clover is stimulated to an even greater extent than on the other basic phosphate plots.

(4) Lime alone is ineffective on this type of soil. The improvement in the quality of the crop is small and there is no increase in the crop yield.

Fig. 8, 9, and 10 which show turfs from the high soluble slag plot, the untreated, and the Gafsa phosphate plot, give some idea of the contrast which met the eye when walking over the plots.

TABLE 8 —PERCENTAGE OF GROUND SPACE OCCUPIED BY THE VEGETATION ON THE PLOTS AT HORNDON.

Manures sown: 28th February, 1918; Analysis made: August, 1919.

Plot	Manure (Dressing 200 lb. Phosphoric Acid per acre)	Clover	Grass	Weeds	Bare Space
		per cent.	per cent.	per cent.	per cent.
C	Lime alone	15·1	34·6	30 0	20·3
1	Florida pebble phosphate	46 0	30·6	13 3	10 1
3	Algerian " "	47·4	30·1	7·4	15·1
5	Open Hearth high sol. basic slag ...	44·1	28·6	13 7	13·6
6	Untreated	4·2	14·8	31·0	50 0
8	Gafsa phosphate	41 3	32·3	57·6	8·8
9	Tunisian phosphate	38·5	36·9	21·0	3 6
12	Egyptian phosphate	55·5	41·0	10 7	2·8
13	Superphosphate (200 lb. P_2O_5 per acre)	23 9	57·3	0·7	18·1
14	Superphosphate (50 " " ")	18·8	25·3	18·8	37·1
15	Superphosphate plus 1 ton (as for 13)				
	of lime per acre	60·0	32·7	1·4	5 9
16	Untreated	9·4	19·1	26·0	45·5
17	Open Hearth high sol. basic slag				
	(same as for Plot 5)	46·2	47·2	1·4	5·2
18	Open Hearth (Fluorspar) basic slag				11·1
	(low soluble)	43·8	31·8	13·3	18·0
H	Cleveland phosphate	43·1	33·3	5·6	

Conclusions.—Rock phosphates produce exactly the same type of improvement in the quality of the hay crop and the

FIG. 8.—Turf from Basic Slag (high soluble) Plot at Horndon, August, 1919.

FIG. 9.—Turf from untreated Plot at Horndon, August, 1919.

FIG. 10.—Turf from Gafsa Rock Phosphate plot at Horndon, August, 1919.

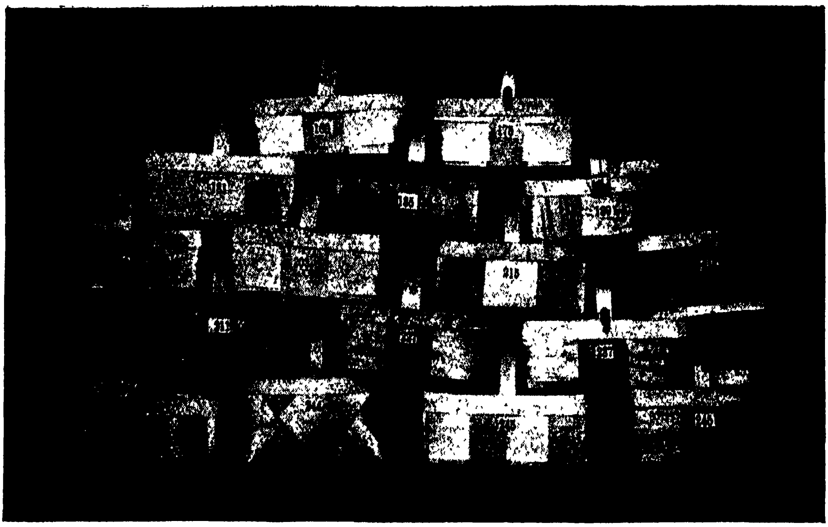

FIG 1.—Standard Chip Baskets, sizes 3 and 4. Nos. 4 to 19 inclusive in order of capacity reading from left to right and downwards

pasture as the most soluble types of open hearth basic slag, and they are quite as effective in this respect.

The open hearth low-soluble fluorspar slags are not so consistent in their behaviour. The evidence suggests that the less soluble types do not improve the hay crop to the same extent as the high-soluble slags.

The action of phosphates on grass land is not confined to developing the clovers. They have a very decided effect in improving the quality of the grasses. The evidence available does not agree with Middleton's suggestion* that the improvement of the grasses is due to the collection of nitrogen by the clover plant. It is more likely to be due to the grasses benefiting by the direct fertilising effect of the phosphates or to the phosphates having some action on the production of nitrates in the soil, or to the operation of both these causes.

STANDARDISATION OF CHIP BASKETS.

J. STODDART,
Ministry of Agriculture and Fisheries.

ONE of the most striking features observed when visiting the chief distributing markets this summer was the heterogeneous collection of packages and baskets used in marketing the soft fruit crop. In no other industry is there shown such a complete disregard of the essential needs of standardisation as affecting economic distribution. As might be expected, enquiry amongst producers and distributors concerning this condition reveals an extraordinary lack of unanimity of opinion except that some kind of reform is needed. The position in regard to non-returnables, particularly the baskets used for strawberries and popularly known as "chips" is most noticeable, possibly because, at first sight, they appear to be easily amenable to standardisation.

In spite of the general desire for reform a state of inaction persisted, possibly because those concerned were waiting for someone to give a lead. The Ministry of Agriculture arranged in 1920 for a full investigation into the need for and the means whereby fruit packages could be standardised, and the result of this investigation clearly showed that distribution of fruit

* *Journal of Agricultural Science*, Vol. I, p. 131.

would be facilitated and possibly cheapened if the use of packages were limited to those which had been standardised. Soon after an agreement was reached as to the standardisation of the apple box, and a public Conference was called at the Imperial Fruit Show of 1921 to consider the possible standardisation of other packages. At the Conference it was generally agreed that standardisation was necessary, but that more investigation was necessary before the actual details could be settled. During the early part of the present season, therefore, a further investigation was made to obtain sufficient data to permit of the settlement of definite standards. The collection of these data was done by the writer and the following gives a brief outline of the investigation.

To ascertain the exact position, specimens of chips at present in use were obtained and a determination made of their capacity, with the results shown in the following table:—

Sample Number.	Cubic capacity, in inches, level with top of basket,	Sample Number.	Cubic capacity, in inches, level with top of basket.
Makers, No. 2 Size		*Makers, No. 4 Size*	
1	130	13	211
2	132	14	227
3	144	15	237
No. 3 Size		16	239
4	160	17	244
5	175	18	245
6	181	19	245
7	185	*No. 6 Size*	
8	189	20	343
9	193	21	365
10	203	22	385
11	215		
12	215		

The capacity was ascertained by filling each chip with haricot beans, the true cubic capacity of which was then determined by weight (allowing that 1 oz. beans had a capacity of 2.03 cu. in.). In every instance the beans were shaken down to secure consistent settlement and means were provided to prevent distortion of the package from the normal. By this method the capacity can be obtained with a margin of error probably not exceeding more than 2 per cent. The illustration shows the chips of sizes 3 and 4 that were tested.

The measurement of baskets with fruit would have been more difficult, for the weight capacity of any one basket of soft fruit, and particularly strawberries, varies with the season,

the variety grown, and size of berry. In the present investigation attention was mainly directed towards ascertaining the necessary cubic capacity of a basket for packing 3 lb., 4 lb., and 6 lb. of the more common varieties of strawberries, and the actual space occupied by, say, 1 lb. of strawberries. For these investigations the sample baskets Nos. 4 to 22 were used and filled with fresh berries of the Royal Sovereign strawberry picked in the middle of the season. As a result of many tests it would appear that 1 lb. of strawberries actually occupied a space of some 58 cu. in.

As strawberries, however, vary considerably in size and must not be pressed in the basket, it is obviously impossible always to pack the same weight in a constant capacity or to allow only 58 cu. in. for each lb.; furthermore, it is necessary to leave space so that fruit will travel with less risk of injury. The package then requires to be ½ in. in height over and above the capacity actually occupied by the fruit. A short review of the table would show that samples No. 1, 2 and 3 are made to carry 2 lb. of strawberries, though No. 3 is unnecessarily large. The 2 lb. chip, however, is not favoured by railway companies on account of its small size. The experience of many growers and distributors shows that there is a real need for a package holding small quantities of strawberries suitable for sale intact by retail and that berries so packed realise higher prices than when packed 3 lb. or 4 lb., in support of which one might refer to the development in the Tamar Valley of the non-returnable crates holding 54 punnets, each containing ½ lb. fruit; and of the chip containers holding eight 1 lb. punnets in use in the Swanwick area.

The nine samples numbered 4 to 12 and sent out by the makers for packing 3 lb. of strawberries have capacities varying between 160 and 215 cu. in., the difference between the largest and smallest being 55 cu. in. The basket No. 4 cannot possibly hold 3 lb. of freshly picked strawberries. No. 5 is too small for 3 lb. of large but might take 3 lb. of small berries. No. 6 carries 3 lb. if the centre is raised to the level of the top but would be too small for 3 lb. lighter weight berries than Royal Sovereign. No. 7 has a slightly larger margin, which is further increased in Nos. 8 and 9. No. 10 is of sufficient capacity to hold 3 lb. of almost any variety of berry well below the level of the top. Nos. 11 and 12 are unnecessarily large. The figures would indicate that a working standard for strawberries can be fixed between 190 cu. in. and 200 cu. in.

At times these baskets are used for packing gooseberries, currants and cherries, when a capacity of 200 cu. in. is required to pack 4 lb. of fruit packed level with the top; so that if the standard chip is to carry 4 lb. of these fruit 200 cu. in. should be adopted. For general use, however, it would be more economical to pack strawberries in a basket allowing 190 cu. in. for the 3 lb. chip.

The seven baskets numbered 13 to 19, have capacities varying from 211 cu. in. to 245 cu. in. No. 13 is too small and has in fact a less capacity than the largest of the No. 3 size. No. 14 is a little too small; Nos. 15 and 16 are correct for the bulk of the crop; and Nos. 17, 18 and 19 have an ample margin for all except the lightest weight berries. Generally, however, a capacity of 245-250 cu. in. would be sufficient to allow for the 4 lb. chip and a basket of this size would also carry 5 lb. of gooseberries, currants or cherries.

Apart from the capacity the variation of dimensions is a matter calling for consideration. For economic stacking and transport the ideal chip is one in which the length is approximately twice the width with a depth slightly less than the bottom width. The adoption of uniform dimensions based on the proportions given would benefit all concerned in transit and distribution. The following tentative dimensions are offered for consideration:—

No. 3 size, inside measure—

Top	$11\frac{1}{4}$ in. x $5\frac{1}{2}$ in.	$3\frac{5}{8}$ in. deep for 190 cu. in.
Bottom	10 in. x $4\frac{1}{2}$ in.	$3\frac{3}{4}$,, ,, ,, 200 ,,

No. 4 size, inside measure—

Top	12 in. x 6 in.	$3\frac{7}{8}$ in. deep for 240 cu. in.
Bottom	$10\frac{3}{4}$ in. x 5 in.	4 ,, ,, ,, 250 ,,

Strength is not less important than capacity and dimensions, and it is to be regretted that many of the chips at present in use are too flimsy to afford adequate protection to the contents.

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FARM INSTITUTES.

PART III.

This article concludes the summary of the training provided at the Farm Institutes which have been established in this country. The two previous articles, dealing with eight of the Institutes, appeared in the August and September issues of the JOURNAL. *The account below refers to the Institutes established in Hertfordshire, Staffordshire, Monmouthshire and Carnarvonshire.*

HERTFORDSHIRE AGRICULTURAL INSTITUTE.—The Oaklands Park Estate of 335 acres, comprising a mansion house, offices, gardens and grounds, and the home farm, was acquired by the Hertfordshire County Council in 1919 for the purposes of a residential Farm Institute. The Institute is situated 2 miles from St. Albans, is fitted up with a recreation room, laboratory, lecture room, library and museum, and has accommodation for 30 resident students (20 male and 10 female). Mr. J. B. Hunter-Smith, B.Sc., is Principal of the Institute and Agricultural Organiser for the County.

Instruction is provided for pupils of both sexes in the science and practice of agriculture, dairying and horticulture. The instruction aims at showing students how to make a living out of farming. Residential students are required under proper supervision to take part in all seasonal work on the farm, with the stock, or in the dairy or gardens. Trials are conducted with different crops, manures and methods of cultivation, and an endeavour is made to test different systems of farming. Experiments and demonstrations on economic lines are also arranged at various centres in the county. Detailed records are kept of the production and cost of crops, meat, milk, etc., the results and statistics being published.

Lectures and short courses of instruction for farmers and farmers' sons are held at the Institute and at suitable centres in the county. These are supplemented by demonstrations and advisory visits.

The Farm.—The farm consists of about 300 acres of typical Hertfordshire land, of which 160 acres are arable, 100 acres grass, and the rest woodlands and gardens. A herd of 20 Dairy Shorthorns is maintained and the live stock also includes two breeds of pedigree pigs and ewes for crossing for early lamb production. A special feature will be made of baby beef production. The farm equipment includes a silo.

A large reconstructed building provides ideal accommodation for all dairy work. Special attention will be given to clean milk production (including bottling and marketing) and soft cheese-making. An area of nearly 4 acres is available for a horticultural department, and the gardens, to which an apiary is attached, comprise $1\frac{3}{4}$ acres. They provide scope for practical instruction in market gardening, fruit culture, tomato growing, and floriculture, and will be run on commercial lines. In the spring of this year a poultry department was started, and this is now being extended.

Courses of Instruction.—The main agricultural course is arranged in three 12-week terms covering a complete farming year, from October to August, and students are recommended to attend for the whole year in order to become conversant with the different aspects of farming practice. This course is designed for young men who intend to become farmers, bailiffs, or estate agents, and has for its aim the training of the eye and hand along with the intelligence.

A one-year course in dairying is run concurrently with the foregoing for students wishing to take the British Dairy Farmers' Association's certificates in butter and cheese-making. This course also fulfils the regulations as to practical experience required as a preliminary for the examinations for the National Diploma in dairying.

There are also short courses in agriculture, dairying, horticulture, poultry-keeping, and bee-keeping. The 4-weeks course in agriculture is for non-residential students, and is limited to young men of 17 years or over who have had at least one year's farming experience. Lectures are given daily during 3 weeks in the winter, and one week in the summer is devoted to farm demonstrations and visits to prominent farms and experiment stations in the neighbourhood.

Entrance scholarships are awarded annually as the result of examination; one agricultural scholarship will be awarded to a student intending to continue his studies at an Agricultural College, and one enabling the holder to take a degree course in agriculture at Cambridge University. Certificates are awarded to all students who reach a satisfactory standard in the examination held at the end of the third term.

Experiment and Research.—The Institute maintains direct touch with the farmer and is equipped to carry out investigations of practical and commercial value. Examples of this type of work at present being done are (*a*) an investigation into the

FIG. 1. -Hertfordshire Agricultural Institute, Oaklands, St. Albans.

FIG. 2. Non-pedigree Shorthorn Heifers at Oaklands.

Fig. 3.—Staffordshire County Farm Institute, Rodbaston, Pinkridge.

effects over a rotation of different methods of cultivation, (*b*) field trials of various methods of sowing cereals, (*c*) field trials to ascertain the most profitable crops for silage, (*d*) feeding experiments with silage and roots, (*e*) commercial pig feeding experiments, and (*f*) comparison of various crosses for early lamb production. Work of this description is undertaken because it is of immediate commercial value to the farmer. Every effort is being made to extend these investigations in other useful directions.

STAFFORDSHIRE COUNTY FARM INSTITUTE.—Rodbaston Estate lies (at Rodbaston, Penkridge) in the centre of an important agricultural district and midway between the towns of Wolverhampton and Stafford. The Hall has been adapted for residential and instructional purposes and will accommodate 25 students. It is situated in beautiful grounds away from the main road. The Principal of the Institute and Agricultural Organiser for the County is Mr. J. C. Rushton. A drastic modification of the original buildings planned for the Institute was made necessary by the economic crisis that followed the War, and some of the buildings at Rodbaston are but makeshift in character pending an improvement in the financial situation.

The Farm.—The farm is 315 acres in extent. about one-third being arable. The soil is chiefly of medium loam overlying the new red sandstone, but there are some patches of peaty and of sandy soils. The stock kept on the farm is essentially of a commercial type. A recorded herd of Dairy Shorthorn cattle is being built up; a first-class Dairy Shorthorn bull is kept and the calves are reared. There is a small flock of sheep, and also pigs. comprising pure bred Large Whites and Gloucester Old Spots, the herd being kept largely on the open-air system. At present the horses are kept for ordinary farm purposes but it is intended to raise a registered shire stud. The farm is well equipped with modern machinery, a motor tractor is used for threshing and cultural operations, and gas and petrol engines are used to work the ordinary farm machinery.

Courses of Instruction.—The year's work at the Institute is divided into two sessions. From October to March there is a course for young men in general agriculture. The first part of this course deals with soils, manures and crops from the farming point of view. The requisite instruction in chemistry and botany is provided in other sets of lectures and laboratory work. The

second part concerns live stock, especially the breeds and management of horses, cattle, sheep, and pigs, and the principles and practice of feeding all classes of stock. A special feature of this part of the course is stock judging.

During the summer, the Institute has been available for women students, 25 of whom have been in residence, taking short courses in dairying, poultry-keeping, horticulture, and bee-keeping. The course was extended for a further six weeks to enable students to obtain further instruction in cheese-making.

Throughout all the courses a large proportion of the time is occupied in ordinary practical operations affecting each subject of instruction, and every student is expected to take part in the work.

Certain scholarships and maintenance grants are offered for competition.

MONMOUTHSHIRE AGRICULTURAL INSTITUTION, USK.—The Monmouthshire Agricultural Institution at Usk was established in 1913 under a Scheme of the Board of Education under the Charitable Trusts Act, and is under the control of a Governing Body consisting of 18 representative Governors and 2 co-opted Governors, 10 of the representative Governors being appointed by the County Council. Up to the present the Institution has been independent of the Local Education Authority and has been maintained out of Trust funds, no grant being made in aid of its work either by the Ministry or the Local Authority.

Mr. J. C. Newsham, F.L.S., formerly Principal of the Hampshire Farm Institute, has occupied the post of Principal of the Institution since its establishment.

The Farm.—The Governors were fortunate in purchasing a mixed farm of nearly 300 acres from the Marquis of Bute. The Farm is not only geographically central in the county, but also affords typical examples of the farming of the district. It is cropped largely on intensive lines, and although the greater portion of the land is of a light loamy character, there are also heavy and medium soils which provide variety in the systems of cultivation. There are hill pastures, moreover, in addition to the meadow land along the valley of the Usk.

New farm buildings were completed in 1917 and now embody the latest improvements for effecting economy in the housing and feeding of live stock, while suitable provision is made for carrying out feeding experiments. The block of buildings includes a well-equipped milking shippon, covered yards, calf pens,

horse stables and barns. The last named are provided with the necessary modern machinery for the chaffing, pulping, grinding and preparation of foodstuffs. The piggeries, Dutch barn, and implement sheds are all detached from the main block of buildings, as is also the dairy.

The live stock includes a herd of pedigree and non-pedigree Dairy Shorthorns, Hereford cattle for fattening, a small pure-bred flock of Oxford Down sheep, and several Shire mares for breeding. Of pigs, pure-bred Large Whites, Large Blacks, Middle Whites and Berkshires are kept, and these are largely used for crossing purposes. Demonstrations in the feeding of cattle, calf-rearing, pig-feeding and breeding are undertaken, while on the farm, trials of varieties of grain, root, and forage crops are carried out from time to time, and also manurial trials and the testing of new practices.

Horticulture is a special feature of the Institution's work, sixteen acres of land having been set aside for the cultivation of hardy fruit, vegetables and florist flowers, the ground being intensively cropped for commercial market-gardening on the most improved system. This department serves the dual purpose of providing instruction for students, and a demonstration centre for the more intensive methods of cultivation, and the testing of new varieties. The demand for fruit and vegetables is considerable throughout the large industrial areas of South Wales, and the establishment of this department at Usk should do much to stimulate market-gardening throughout the county, as much of the land on the eastern side is very suitable for both fruit and vegetable growing.

The Dairy is provided with the necessary appliances for dealing with the whole of the milk supply from the dairy herd of some thirty cows. Practice is given in the manufacture of the commoner varieties of hard and soft cheeses, the management of milk and cream, milk testing, milk recording, elementary dairy chemistry, butter-making, and dairy management generally. The production of clean milk from the practical dairy farmer's standpoint is also demonstrated.

Poultry-keeping is practised on the semi-intensive system, four acres of land having been allotted to this department. It is well equipped with the necessary buildings, including suitable brooder and laying houses, and Mammoth and smaller incubators. The students are taught to make many of the principal poultry appliances themselves, this work being largely engaged in during the winter months. Of breeds of poultry, White

Wyandotte and White Leghorn are kept specially for egg production, while other breeds include Ancona, Rhode Island Red, Light Sussex, and Indian Game, considerable trade being done both with sittings of eggs and day-old chicks. Of other poultry, Khaki Campbell ducks and Toulouse geese are kept at present.

Courses of Instruction.—The average age of the students is about seventeen years, and those taking general agriculture come usually for one year or two years, a certificate and diploma, respectively, being awarded to those who pass their examinations satisfactorily at the end of one or two years. Shorter courses are also arranged, the Institution year beginning in October and consisting of two terms each of 22 weeks' duration. Students may also specialise in any of the other departments of horticulture, dairying, or poultry-keeping.

Considerable attention is given to instruction in all manual processes so that students may be better able to understand the application of science to practice with no doubts left in their minds as to the reason for any particular operation. It is not considered that very elaborate or costly class-rooms are essential, as there is no class-room instruction equivalent to that which can be given in the open fields, cowsheds, stables and workshops.

Owing to the postponement of the erection of the residential portion of the Institution buildings, it became necessary to acquire accommodation for students in the form of hostels. The boy students are housed in a commodious and pleasantly situated house on the banks of the Usk, within easy distance of the farm, while the girls are accommodated in the farm house, a matron being in charge of each hostel.

Periodical visits are paid to the Institution by parties of farmers, young farmers' clubs, and various associations of gardeners, allotment holders and poultry keepers, and these afford opportunities for useful and practical discussions. Numerous technical inquiries are dealt with by the staff. Small holders, in particular, regard the Institution as a place to which they can look for assistance and advice in all matters relating to their work. While, however, the Institution is the centre of a great deal of the county's agricultural activities, it has so far, as already stated, been conducted independently of the Local Education Authority, which employs its own County Agricultural Staff. The question of utilising the School and farm in connection with the general work of agricultural education in the county has recently been under consideration, and the Governors and the

County Council have decided to apply to the Board of Education for an amending scheme under which it is proposed that the control of the Institution shall be transferred to the County Council. It is contemplated that the Institution shall then become the centre for all agricultural education conducted under the Council and be recognised by the Ministry of Agriculture as a Farm Institute for the county.

MADRYN CASTLE FARM SCHOOL.—The Carnarvon County Council was the first Council in England and Wales to establish a Farm School under the Development Fund Regulations, the Madryn School being opened in 1913. The Council took active steps in the formation of small holdings under the Act of 1908, and felt that it was a condition of the real success of the movement that it should be supplemented by a well organised and comprehensive scheme of rural and agricultural education. Moreover, they were alive to the need for disseminating modern ideas of farming amongst the agricultural community of the Lleyn Peninsula, and for giving instruction in improved methods of cultivation. When therefore in October, 1910, the Madryn Estate, extending to an area of about 2,239 acres, and comprising a mansion together with extensive outbuildings and a walled garden, was acquired for small holdings, it was decided to convert the Castle into a farm school and to farm the adjacent land as a demonstration holding.

The School, which is about 7 miles from Pwllheli—the nearest railway station—is situated in the heart of the Lleyn Peninsula, an extensive agricultural district containing an exceptionally large percentage of small holdings.

The mansion is ancient and historic and appeals strongly to local sentiment, as it was, previous to its acquisition by the County Council, the home of the family of Love Jones Parry, who was descended from the North Wales princes, and was the hero of the political revolution of 1689. It has been adapted for teaching and residential purposes, and contains accommodation for the resident staff and 30 students.

The Farm.—The farm is about 200 acres in extent, of which 170 acres are arable and meadow land. The soil, which is loamy in character, is well adapted for the growth of most of the ordinary farm crops.

The farm is managed as a mixed holding. The native breed of Welsh Black cattle is kept and a herd of about 14 dairy cows is maintained. The majority of the calves are reared. Field experiments are conducted in connection with varieties of potatoes,

seeds mixtures and crossing of sheep, as well as demonstrations relating to fruit trees planted on grass.

Courses of Instruction.—A winter course lasting for 20 weeks from October to March is designed for farmers' sons and others who propose taking up farming. The theoretical teaching consists of lectures on soils, manures, crops, live stock, farm implements and machinery, veterinary science and land surveying. This work is supplemented by demonstrations and practical work on the farm. Students attending this course have ample opportunities of learning all the more important operations obtaining on a mixed farm, and the feeding and general management of live stock.

A summer course in dairying and allied subjects, extending over 12 weeks (May-July), is primarily arranged to meet the requirements of farmers' daughters. Modern methods of handling milk and dairy produce are taught. Butter-making and the manufacture of ordinary hard and soft cheeses form an essential part of this course, which includes also instruction in poultry-keeping and bee-keeping.

Arrangements are made by which students attending either of the above courses can receive instruction in practical gardening. The garden attached to the School is over 4 acres in extent, and is well stocked with fruit trees. Market gardening is a special feature of the work.

A course in school gardening and rural science for elementary school teachers is also arranged when necessary during the midsummer holidays. Much importance is attached to these classes by the Local Authority, as it is realised that it is only through the teacher that a proper " atmosphere " for agricultural education can be created amongst the rising generation.

The poultry department consists of about 300 head of the leading breeds of poultry. A large number of ducks and a flock of geese are also kept. Artificial and natural hatching are carried on and the selling of day-old chicks and sittings of eggs forms an important part of the activities of this department.

The dairy is equipped with modern apparatus and opportunities are thus afforded to train students in the most modern methods in the management of milk. Milk recording and milk testing receive special attention.

Theoretical and practical instruction is also given in apiculture. Carniolian, Italian and hybrid swarms are kept, and the apiary consists of about 20 hives.

A limited number of entrance scholarships are awarded to pupils from Carnarvonshire who propose attending courses at the school, and also leaving scholarships on the result of an examination held at the end of each course, to enable pupils to proceed to one of the University Colleges, or to some recognised centre for advanced dairy instruction.

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A VILLAGE HISTORY EXHIBITION AS AN EDUCATIONAL FACTOR:

AN EXAMPLE FROM THE WEALD OF KENT.

GUY EWING, J.P., F.S.I.,
Member of the Kent C.C.

THE unit of national patriotism is surely the parish. The parish, the county, the country—these are the steps. This is clearly recognized by the promoters of one great movement which is directed solely to the improvement of the conditions of country life. The Village Clubs Association, already a great organization in this country, and one recently and eagerly copied by the French, realizes that the village is a self-contained unit of the countryside, and, better still, it realizes that while the villagers want clubs, they want clubs like gentlemen's clubs, where the members elect their own committees and frame their own rules, where they trust one another to behave properly and deal with offenders themselves. A club, under the Association's constitution is to be a headquarters for all village activities, and the centre for all schemes of recreation and improvement. Improvement is asked for by the villagers, but it must be tactfully supplied. Lectures suggest high-brows and long words, addresses are suspected as inspired by "causes."

An experiment in what is, at any rate in Kent, a new line has recently been tried, which seems to have been wholly successful. The promoter, forced by years to have a good deal of leisure, occupied himself with a study of the records of an ancient parish in the Weald of Kent. The Registers, dating from 1566, complete with the exception of two years, he transcribed, and a valuable account book of the Parish Officers from 1599 to 1714 he analyzed. Various other documents, including ancient deeds and the admirable publications of the Kent Archæological Society, yielded much interesting information, incidentally showing that some of the families have been settled in the parish since the

15th century. Then, when the Village Club, which was started in 1921 in affiliation with the Village Clubs Association, was discussing ways and means, being still in debt to the building fund, he suggested a loan exhibition illustrating the parish history. The idea was received politely but without enthusiasm by a committee who did not realize that they had any individual part in their parish history. However, it was agreed to try what was, at any rate, something out of the routine of jumble sales and whist drives.

The promoter got to work, and applied to the big houses first, meeting with sympathy and support, though few realized that they had much to contribute. He then put up a notice in the Village Club asking for the loan of specified articles, or information as to where they could be obtained. This remained up for about six weeks and elicited no single reply of any kind. A letter addressed to four local newspapers may have served as a cheap advertisement for the exhibition, but it only brought one letter. This was from a lady in a neighbouring parish who offered a copy of a small volume of "Poems and Songs" by a village "cordwainer" published by subscription in 1854. This was really one of the foundation stones on which the edifice was built. The local shoemaker-poet had begun his collection with an ode to the parish concerned, full of allusions to families and places. He had also addressed "Recollections" to the village miller with references to his playing of the "Violoncello. in the Parish Church." A visit to the grandson of the miller resulted in the loan of the identical instrument and many other articles belonging to former days, such as brand-irons, a sampler, and an old flint-lock fowling-piece. In addition, information was forthcoming about other relics in other houses, and then the list began to grow rapidly. At one time the promoter, in fear lest his exhibition should come to naught, had applied to a local dealer in antiques for the loan of examples of the iron industry for which the parish was famous in the 16th and 17th centuries. He promised to lend whatever was required but ultimately a man-trap was all that was asked of him. An inquiry from a stranger, a famous collector who wanted an extract from the Registers concerning a tradesman who issued tokens in the reign of Charles II, led to a correspondence, and the gift of rubbings of the very few specimens known to exist. Landowners lent fire-backs and fire-dogs, ratchet pot-hooks and other specimens of the work of the local furnace. Ox-yokes, flails, shepherds' crooks, a horn-lantern, waggon bells, sickles, and a variety of

obsolete agricultural implements came from different farm-houses. Flint and steel, tinder-boxes, rush-light holders, one being a rather unusual type formerly in the belfry, needle-work pictures, a horn book, a pair of gloves made in the village 25 years ago when glove-making was a considerable industry there, poke bonnets, smocks, locally known as round frocks, a straw "topper" worn by a cricketer at the end of the 18th century, a wooden trencher, and a pair of scales made out of trenchers, mothering-irons—in fact a great variety of relics and antiquities beginning with flint-implements and ending with the silk flag and stewards' wands of the Benefit Society now defunct—were produced. Flint-lock guns and muzzle-loading volunteers' rifles were lent, and in their own time four working men of the Committee fetched over two miles an ancient cannon, cast for the Army of the Parliament in the village foundry. The pewter Church Plate bought by the churchwardens in 1663 to take the place of that which disappeared at the Reformation came from the rectory. The Parish Registers and account book, referred to above, were shown, as well as a letter from the "Chiefe in Habitance" of the Parish declining to accommodate any Palatine Refugees in 1709, on the ground that they had more of their own poor than they could "imploy" and no "housing to pott them in." This was lent by the Secretary of the Kent Archæological Society.

A curious old diary, kept by a carrier at the end of the 18th century, threw light on one of the causes of the decay of the iron industry in the Weald. He not only took considerable quantities of guns and shot to Woolwich, but brought back "cole" for the "furnis," owing, no doubt, to the exhaustion of wood fuel.

A pillion saddle and a spinning wheel, both in use little more than a hundred years ago, were curiosities that very few of the villagers had ever seen the like of, though many of their grand-mothers used both.

Outside the parish, not many of the families have ever made a name, but one of the Commissioners who tried Charles I came from it, and in later years it has boasted a Lord Justice of Appeal and his son, a well-known London Police Magistrate, a Privy Councillor and University Member, with his brother, a Bishop. Caricatures by Spy and Ape were exhibited of the last four and a large collection of portraits of them and of others, both gentle and simple, was shown.

Paintings, drawings, prints, and photographs illustrated houses in the parish, some of them now no longer standing. The representative of a family, established in the parish since 1510 at least, sent portraits and needlework of the last century but one.

No charge was made for admission, but visitors were invited to make a contribution to the Club funds. It is believed that not one left the building without giving something, while two ladies sent additional donations on the following day to mark the delight that the exhibition had given them. The total result was an addition of about £21 to the funds of the Club, but the real success was the interest shown by all who visited the exhibition. Young men who wandered in with an off-hand listless air soon became absorbed in the things themselves and in the descriptions, written in block letters, that accompanied them. These were sometimes on half-sheets or more of notepaper, with references to families and places from the Parish Records and other sources. It was worth a good deal to see the delighted surprise with which one would draw his fellow's attention to the name of his family or home in an extract from the early records. A popular exhibit was a list of " Early Mention of Present-day names of Places and Families " in the parish. There were over 60 of these, nothing being admitted of later date than the Restoration. Three examples will show what is meant:—

Waystrood or Whey Strood	Left by John Still to his son Thomas in 1471. It remained in the Still family till about 1760.
Still - - -	Thomas Still was witness to will of Robert Ludwell, 1456.
Ludwells - - - -	Takes its name from the family of Ludwell mentioned above.

The descriptive labels were, of course, an essential part of the exhibition, and were carefully written to include as many names, still familiar, as possible.

Various circumstances prevented the Club from keeping their exhibition open for longer than one afternoon from two till nine, but next year it is proposed to hold another on a larger scale. This year the exhibits ran into hundreds, but the expected has happened—several have come forward who could have lent things had they realized that what was wanted was common everyday objects of former generations. It is also intended to invite the Education Authorities of neighbouring parishes to bring parties of children to the exhibition, which will remain open for three or four days. Through the winter the promoter hopes to discuss the subject of parish history at the Village Clubs and Women's

Institutes of the countryside. If he succeeds in fanning the spark of local patriotism in only one or two, in showing them that they have traditions of family and parish to live up to, he will not have laboured in vain. Though ostensibly intended as a means for raising money for the Village Club, the promoter hoped all along that the exhibition might have some of the results which it has achieved.

The constitution of the Village Clubs Association adopted by the club in question, a constitution which insists upon freedom from sectarian or party attachment, and from any element of patronage—all of them frequent causes of disaster to similar institutions in the past—greatly assisted in the promotion of the exhibition. Working-men members of the Committee, as related above, fetched the cannon to the village, others helped to bring the trestles and boards from the Nonconformist Church, and set them out, women members of the Committee arranged to supply tea, which, sold at reasonable prices, yielded a profit of about ne pound to the Club funds, and, in various ways, all helped nd none hindered.

The parish is a purely agricultural one, the population being about 700. In the beginning, probably in the 12th century, it was part of the dense Forest of Anderida, occupied by English swine-herds guarding the pannage-rights of Norman Lords of the Manor, by whom, most probably, the church was built. Gradual clearing of the forest by the swine-herds, as their families grew, brought considerable tracts under the plough, and the clearance of trees felled for fuel for the iron furnaces added more to the area in the 16th and 17th centuries. It is worth noting that the iron industry seems to have been a " foreign " undertaking. The ironmasters were not of the soil, they came from elsewhere and left when the furnaces were closed down. There are no records to show that the natives ever left their agriculture to take part in it. Indeed, so far as the Registers tell us anything, it would seem that those who were brought from the furnace for burial in the churchyard, were strangers. The old families stayed on their land, and their names remain, in some cases, to this day. They grew hops (after their introduction in 1525) and wheat, " pods " and " otes," and continued to do so till the railway came, about forty years ago. This caused a revolution in their agricultural methods, and started a new period in the history of the parish. Thirty miles from London, with a station at their gates, milk production and the lure of ready-money once a month led to a complete change in agriculture and

the disappearance of many old names among the farmers and labourers. There is not one acre under hops in the parish to-day, but many oast-houses, converted into cottages, and many field-names ending in " garden " testify that they were once abundantly grown. Grass has taken the place of arable to a great extent but, once more, the name of the " field " and its furrow-long measurement show where the Saxon, or, more properly, the Jute, ploughed his acre a day. The population remains fairly stationary, though many of the husbandmen have given place to gentlemen's servants, and the yeomen's houses are converted into " week-end residences with bath-rooms and lounge-halls " as the house-agents have it. In view of such a revolution it is certain that if no record is made to-day of what remains, the chance will be gone for ever in a very few years. By stimulating the interest of the villagers in the history of their families and homes we can do much to help forward the work.

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LIVE STOCK AND HORSE BREEDING IMPROVEMENT IN ENGLAND AND WALES.

REPORT FOR THE YEAR 1921-22.

PART II.—LIGHT HORSE BREEDING.

So far as the operation of the Ministry's schemes during the season 1921 is concerned there is little variation to report. The arrangements for the location of stallions were made in conjunction with the new Sub-Committees of the County Agricultural Committees on lines similar to those which obtained when the original County Light Horse Breeding Committees were in existence.

The number of premiums awarded in 1921 was the same as in 1920 except that three additional premiums were awarded for Welsh Cobs, and ten for Welsh Mountain Ponies, while the number of premiums to Riding Ponies was decreased by one. It is interesting to note that although the average number of mares served by the King's and Ministry's Premium stallions combined was the same as in the previous year, the average number for a King's Premium stallion increased by four, whereas the average number for a Ministry's Premium stallion decreased by ten.

With reference to the licensing of stallions under the Horse-breeding Act, 1918, it is of course premature at present to expect any good results to be noticeable from the operation of the Horse Breeding Act, but the Ministry has evidence that owners of licensed stallions no longer suffer as they used to do from the competition of the unsound travelling stallion, whose chief qualification, in the estimation of the careless mare owner, was the cheap fee at which it travelled, and the clearance of such stallions from the road must in course of time secure improvement in the Horse Breeding Industry.

During the travelling season of 1921 the Ministry's Inspectors were instructed to stop stallions they met on the road and to require the production of the licences, and it is satisfactory to be able to report that in only comparatively few instances were the stallions unaccompanied by their licences and only in seven instances were the stallions unlicensed. Failure to comply with Regulations was also reported to the Ministry by the Police, who took proceedings for offences under the Act and in the great majority of cases convictions were obtained.

It is evident from the working of the Act during the second year of its operation that the necessity of having stallions licensed and of the licences being carried by the grooms when leading the stallions is now generally recognised, and the plea of ignorance, which was so common in the first year, was but seldom made during the season of 1921.

Foaling Results for Service Season, 1920.—The foaling percentage of the 60 stallions awarded King's Premiums in 1920, calculated on the returns furnished to the Ministry by mare owners, works out at an average of 49, which is a decrease of three per cent. on the figure for 1919. The highest percentage (67) was obtained by "French Eagle," belonging to the Llawes-y-Coed Stud.

The average foaling percentage of the 26 Board's Premium stallions was 47, as compared with 44 per cent. in 1919.

Earnings of Premium Stallions for Service Season, 1920.—The average amount paid by the Ministry for the 48 King's Premium stallions was £324 and the maximum £404. the corresponding figures for the 12 Super-Premium horses being £455 and £500. The average earnings of the stallions (including the service fees paid by mare owners) were £390 for the King's Premium horses and £532 for the Super-Premium horses. the maximum earnings being £494 and £590 respectively.

The average payments by the Ministry for the Board's Premium stallions was £189 and the maximum £244, the average earnings of the stallions being £252 and the maximum £334.

Service Season, 1921.—The number of mares served by the 60 stallions awarded King's Premiums was 4,350, an average of 72 mares a stallion.

On the recommendation of the Light Horse Breeding Sub-Committees of the County Agricultural Committees, 26 premiums (termed Ministry's Premiums) were awarded, and these stallions served 1,398 mares, an average of 53 mares a stallion.

Five premiums of the approximate value of £145 each were awarded for Riding Pony Stallions. The average number of mares served was 52 and the foaling percentage of the 1920 service season was 53.

Nineteen premiums of the approximate value of £80 each were awarded for Welsh Cob stallions in 1921, and, in addition, three premiums of £80 were awarded for Welsh Roadster stallions in Pembrokeshire.

On the recommendation of the Dales Pony Improvement Society, four premiums of the approximate value of £80 each were awarded to Dales Pony stallions and five premiums of similar value were awarded to Fell Pony stallions selected by the Fell Pony Committee.

Thirty-three premiums were awarded to Mountain Pony stallions in Wales and ten to those in the New Forest. These premiums varied in amount from £5 to £10.

Thoroughbred Show, 1922.—The Show of Thoroughbred stallions in 1922, was held at the Royal Agricultural Hall on 28th February to 2nd March, and the Judges were Sir Gilbert Greenall, Bt., C.V.O., and Lt.-Col. J. McKie, D.S.O. The number of entries was 88 as compared with 97 in 1921 and 106 in 1920. The drop in entries may be attributed to the uncertainty which existed in the minds of exhibitors as to the continuance of the Premium system. Only eight new stallions were exhibited but none of these were of sufficient merit to receive an award.

Fifty-seven King's Premiums (including 12 Super-Premiums) were awarded, and the King's Cup was won for the third year by "Gay Lally" belonging to the Compton Stud, the Reserve horse being "Scarlet Rambler" as in the previous two years.

		Heavy.					Light.								Ponies (including Welsh Cobs).	Totals.
—		Shire.	Clydesdale.	Suffolk.	Percheron.	Others.	Hackney.	Thorough-bred.	Arab.	Hunter.	Cleveland Bay.	Yorkshire Coach.	Welsh Roadster.	Others.		
Pedigree	Licensed ...	2,316	266	235	38	—	191	161	21	5	7	3	3	—	172	3,418
	Refused ...	167	15	17	3	—	10	7	—	—	—	—	1	—	2	222
Non-Pedigree	Licensed ...	147	14	2	1	80	54	2	2	5	—	1	1	24	65	398
	Refused ...	15	3	—	—	1	—	—	—	—	—	—	—	—	3	22

NOTE.—Non-pedigree stallions are arranged as far as possible under types.

The following diseases or defects are prescribed in the Regulations of 1919 for England and Wales, made under the Act, as rendering a stallion unsuitable for the service of mares, namely:—Cataract, roaring, whistling, ringbone (high or low), sidebone, bone-spavin, navicular disease, shivering, stringhalt, and defective genital organs. The Table hereunder gives the number of each breed or type of stallion in respect of which licences have been refused and the diseases or defects with which the animals were affected. It will be noted that the most common diseases on account of which stallions were refused licences were whistling, roaring and sidebone, which account for 164 refusals out of a total of 244.

NUMBER OF STALLIONS REJECTED UNDER EACH DISEASE.

Roaring.	Whistling.	Sidebone.	Cataract.	Ringbone.	Bone Spavin.	Defective Genital Organs.	Springhalt	Shivering.	General Unsuit-ability.	Total.
48	69	47	26	15	13	6	6	7	7	244

44 appeals were made against refusals of licences, and in 26 cases these were successful.

Horse Breeding Act, 1918.—During the second year's working of this Act, *i.e.*, the licensing year, 1st November, 1920, to 31st October, 1921, the number of stallions licensed was 3,816 and 244 were refused (18 of the latter on appeal). These figures show a slight increase over the number of stallions licensed in the previous season 1919-20, when the comparative figures were 3,749 and 404 respectively, whilst there was a marked decrease in the number of stallions for whom licences were refused. Of the 3,816 licensed stallions, 3,418 were pedigree animals and the remaining 398 were horses that were not entered or accepted for entry in any recognised stud book.

The figures given in the following statement show the popularity of the Shire Breed, the numbers being 2,316, or 68 per cent. of all the pedigree stallions licensed.

National Stud.—The Stud continued to show a satisfactory profit for the year ended 31st December, 1921, the amount being approximately £8,300. During the year it was found necessary to purchase a sire in place of Royal Realm (dead). The stallion purchased was "Silvern," by Polymelus out of Silver Fowl by Wild Fowl, and was bred by Sir E. Hulton, Bt. It won five times as a 3-year-old and was placed 2nd in the St. Leger and Eclipse Stakes. As a 4-year-old it won the Coronation Cup.

The chief items on the credit side of the account were (1) £30,000 realised by the sale of bloodstock, (2) £7,000 by the sale of cattle, and (3) £2,700 for service fees.

Sixteen yearlings were sold in 1921 realising a gross sum of £31,200, *i.e.*, an average of £1,950. The highest price (£8,400) was obtained for a colt by "Tracery" out of "Countess Zia."

The Stud again occupied a prominent position in the list of winning breeders.

* * * * * *

EGG FARMING:

SOME NOTES ON LEAN-TO ROOF TYPE OF LAYING HOUSES.

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Ministry of Agriculture and Fisheries.

IN this *Journal* for August, 1922, p. 463, a brief account was given of the type of laying house used in the Basingstoke district, including the chief dimensions of the 500-bird houses in use on Mr. Holdaway's farm at Woodmancott. The illustrations here-

FIG. 1.—Large Brooder House with roof sloping to the front.

FIG. 2.—Extension of Brooder House, with roof sloping to the back.

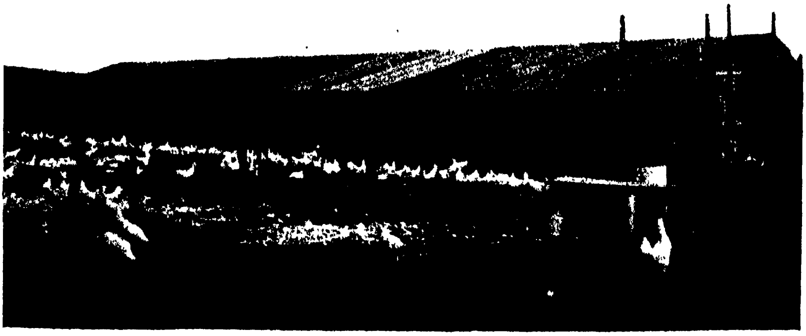

FIG. 3.—Laying House with capacity for 500 hens.

FIG. 4.—Interior of Large Brooder House.

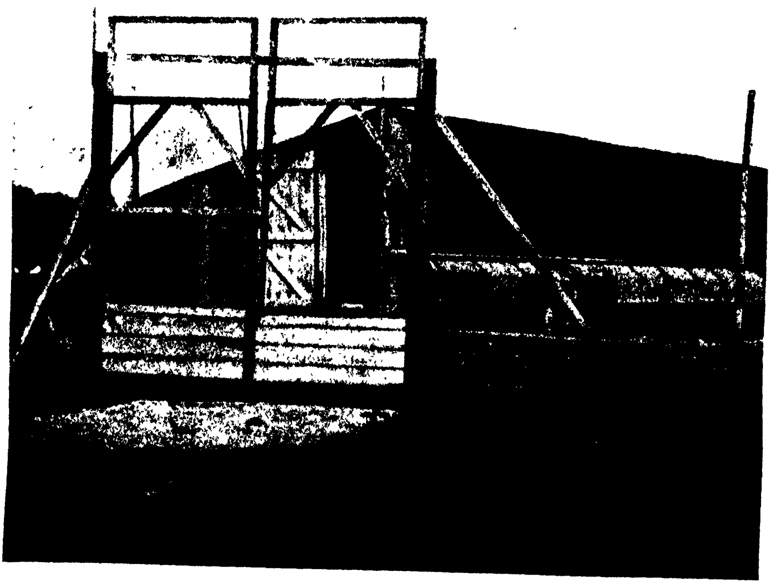

FIG. 5.—Part of the front of Laying House showing large entrance gates.

with were all taken on Mr. Holdaway's farm and will make clear the type of house in use. Fig. 3 illustrates the back of one of the 110 ft. × 14 ft. laying houses having a capacity for 500 birds, and Fig. 5 shows a part of the front and also the large double wire gates to the pen to allow a cart being driven through them.

The houses are of the lean-to type of roof construction, which is by far the most common in use at the present time, and which in practice has proved successful. It is essential, however, that care should be taken in designing houses of this pattern, for it has been found by experience that certain conditions are necessary for the best results.

In considering the main dimensions it is first necessary to decide on what unit of birds it is intended to house, and an allowance of at least 3 sq. ft. of floor space per bird must be given for scratching purposes.

The depth is an important item. Houses of this type were at first made 9 ft. wide, but it was found that this entailed a very long building if, say, a 500-flock unit was to be accommodated, and the tendency now is to make them wider and shorter in proportion. With this type of roof it is not advisable to exceed a depth of 14 ft. unless arrangements are made for back ventilation and also for the placing of windows in the back, an arrangement which entails extra work in construction. Further, if a deeper house is desired it is preferable to employ a different roof construction.

With 14-ft. houses the front should be 8 ft. high to ensure good light at the back and also provide sufficient fall for the roof without making the back too low. If the back is too low trouble will probably be experienced with colds among the birds as there will not be sufficient space above their heads whilst roosting, since the dropping boards must be placed high enough to allow of the space underneath being used for scratching purposes. Another disadvantage of a low back is the discomfort caused to the attendant when cleaning dropping boards.

With regard to the front of the house Fig. 6 gives the details of the front shown in Fig. 5, and shows the correct angle for the hood, this latter being an important detail. The hood is provided to prevent driving rain from entering the open portion of the front of the house during wet weather, and to ensure this the bottom of the hood should be brought down level with the top of the glass. It also comes into operation during the hot summer days, since if the angle is correct the glass front is

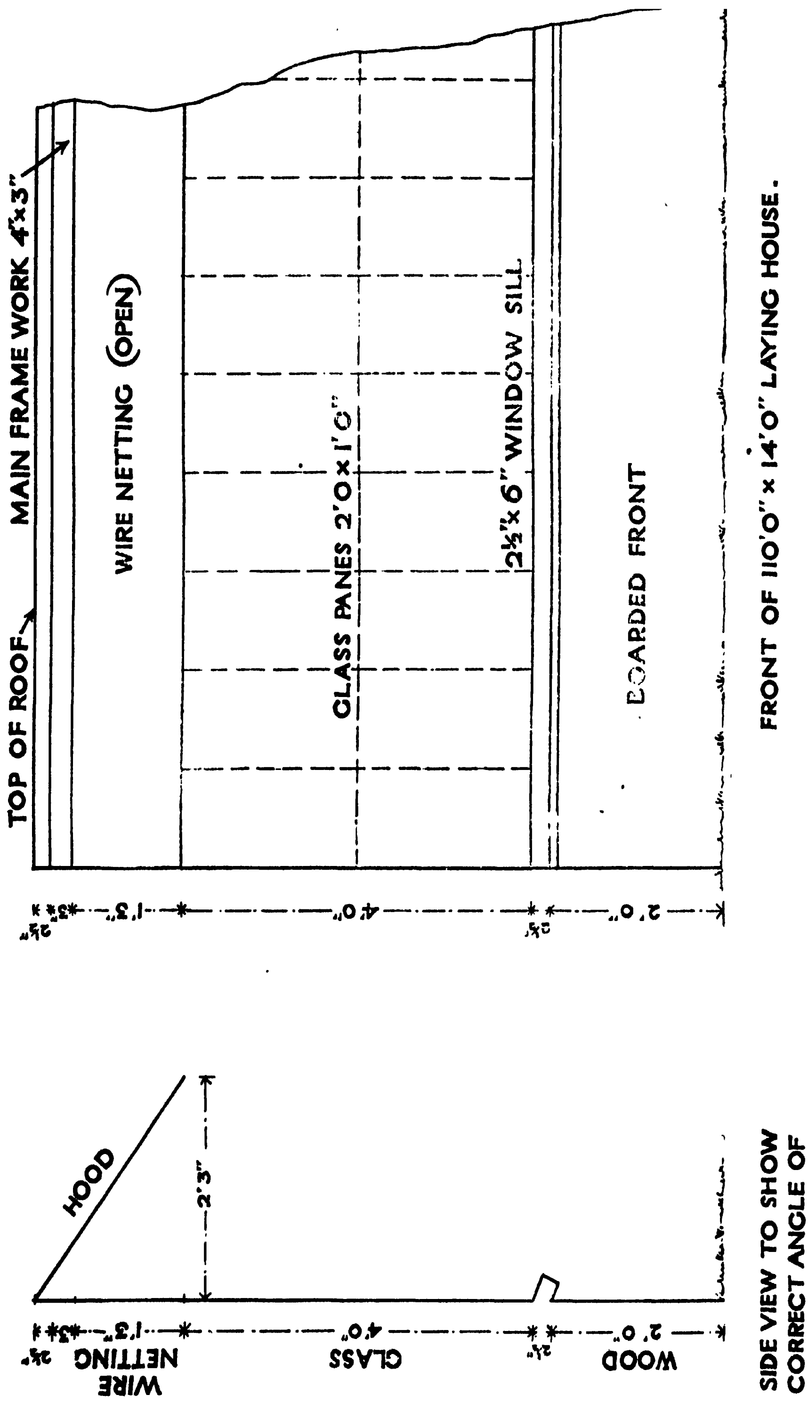

FIG. 6.—Showing the construction of the Lean-to Roof type of Laying House.

shaded by it during the mid-day hours and it consequently helps to keep the interior of the house cool.

In the house illustrated the nest boxes are of the outside type, but the collection of eggs is made from the inside of the house. The bottom of the nests is on the level of the floor but a $10\frac{1}{2}$-in. board is placed in front to prevent litter being scratched into them. In many of these large houses nest boxes are placed on either side of the draught partition, a space being left next to the partition for the birds to gain access to the nest, and a roof at a sharp angle is provided to prevent birds from roosting on it. This system provides darker nests which are sometimes preferred by the birds, but the collection of eggs is not so easy, and they are more expensive to construct.

Dry mash hoppers are placed in any convenient space available, but it should be the aim to leave the floor space free from any obstruction so as to devote as much space as possible for scratching purposes.

The roof, back and sides of the house illustrated are covered with felt, and it will be noticed that wooden strips have not been used for holding down the felt. Each width of felt is allowed to overlap, the upper and lower surface being treated with a mastic cement, and the felt secured to the wood by means of large headed clout nails. By this means a practically solid joint is obtained excluding not only water but wind, which is the chief cause of damage to felt on the roofs of houses. It will be found best to start the felt at the bottom of the hood and carry it over the top of the roof, the strips being put on parallel to the sides of the house, that is, running from top to bottom of the roof.

* * * * * *

CALIFORNIAN METHODS OF POULTRY RAISING AND MARKETING.

II.

Co-operative Marketing.—The Poultry Producers of Central California Incorporated, is an organisation typical of many in California designed to assist the farmer in marketing his produce in the most effective and economical way, and at the same time to obtain for him the best and most stable price possible.

It is proposed first to outline the methods employed at the Petaluma egg-depôt itself, and afterwards to indicate the co-operative principles upon which the organisation is built.

The depôt consists of a large rectangular building of one storey, situated near the railway station, and having sidings and loading platforms along both sides, a third platform being provided at one end of the building for the convenience of automobiles.

Eggs are delivered in boxes of 30 dozen each from the railway truck, or, if the farmer lives in the vicinity, from his motor car. The quantities marked on the card attached to the box by the farmer are compared with those entered on a card inside the box, which is then re-nailed lightly. The boxes are stacked upon a small platform very much like a sled and sent to the re-sorting men upon an ingenious four-wheeled trolley. This is run underneath the loaded sled and jacked up by a single movement so that the sled runners are clear of the ground. Piles of boxes are kept upon the sleds so that they can be conveniently moved at any time with very little labour, and with practically no risk of breaking the eggs. The boxes have already been marked by the farmer according to the grade of eggs which they contain. If a box contains eggs of more than one grade they are resorted and made up into full boxes by the re-sorters.

The complete boxes are then inspected to ensure that their contents reach the standard required for the grade. The eggs, which are packed in cardboard frames of 3 dozen each, are transferred in one movement to somewhat similar metal frames running on a grooved table. They are swiftly looked over by experts who pick out any which are over or under size, dirty or of a bad colour. The frames are pushed along the table by the inspectors and the eggs are re-packed in boxes as they reach the end, the wire frames being shut up and returned along an overhead rack.

The re-packed boxes are nailed up on the spot and removed on the sleds above described for shipment.

The extreme simplicity and effectiveness of this grading process is due almost entirely to the education of the individual farmer in the methods of the institution. The great majority of the members can be trusted to grade their own eggs with considerable accuracy, and the inspection is actually only necessary to ensure a standard common to all the consignments and to detect occasional errors.

For the same reason, candling is very little done, except in the case of new members or for other special reasons. All the farmers whose eggs pass through the depôt are themselves

members, and realise that care on their own part is necessary in order to dispense with more elaborate arrangements, the expense of which would devolve, ultimately, upon themselves.

The above process is extended in the case of dirty eggs and of eggs for preserving. The dirty eggs are placed upon an endless band of rubber-covered rollers which is passed beneath a funnel emitting a sand blast. As the rollers cause the eggs to revolve they are thoroughly cleaned without the deleterious effect caused by water.

The eggs for preserving are placed upon wire frames similar to those used by the inspectors and immersed for a second or two in oil which is kept at a temperature of 250° Fahrenheit. This has the effect of driving out the air and of sealing the egg, thus rendering it capable of preservation for some months. It may be noted in passing that members are expected to send only sterile eggs to the depôt.

After the completion of the various processes, the boxes are stacked according to the grade of eggs which they contain and loaded on to barges for shipment to San Francisco, or on to railway wagons if for shipment by land.

It will be noted from the above that the association does little beside co-ordinating the efforts of individual farmers. It in no way relieves them of the responsibility of delivering their eggs in the best possible state for marketing. If the grading and packing work at the depôt runs smoothly, it is because the farmers themselves have taken great pains that it should do so, by performing their own task as efficiently as possible. This is a point of some importance, as indicating the value of individual care as a first constituent of co-operation.

It might be thought that, since only some 65 or 75 per cent. of farmers in the district are members of the Co-operative Marketing Association, its usefulness was problematical. Actually, the proximity of Petaluma to the markets of San Francisco and the Bay Cities adjacent thereto makes it a simple matter for many farmers to make contracts for the sale of their eggs without having recourse to the association: it is when the industry outruns its local market that such a society becomes necessary. In short, though a prosperous co-operative society may be regarded as a criterion of the success of an industry, it is a result of success rather than its cause.

Constitution of Societies.—The question of the constitution of co-operative societies has received much attention in California. Such societies are to be regarded as accessory to the individual in

his business, and not as profit-making concerns. They are to provide assistance to the farmer in proportion to the size of his business through them, and to ensure that none but he and his associates have the controlling interest. The constitution of the Poultry Producers of Central California Incorporated, follows the main principles which have now been accepted in this country as essential for *bona-fide* co-operative concerns. The initial capital is supplied by local poultry farmers and subsequent issues are governed by the size of the applicant's poultry ranch, *i.e.*, he can only be allotted one $10.00 share for every 1,000 hens or majority fraction thereof owned by him. Since he must, upon joining, sign an agreement to sell and deliver to the society all the eggs and poultry which he markets, it will be seen that the stock is fairly equitably divided.

The society is governed by a board of eleven directors, all of whom must themselves be poultry producers. An exception is made in the case of one of the directors, who is nominated by the State Market Director of California. There is an Executive Committee of five directors, and a salaried general manager. In addition to the usual annual accounts, the society issues a monthly auditor's financial statement showing the assets and liabilities, and the volume of business and operating costs during the month in question.

Methods of Selling.—The society sells the eggs at the best price it can get, and hands over the proceeds at the average price for the week to the producer, less the cost of the egg-boxes and certain other expenses. These include transportation, and a charge not exceeding 1 cent. per dozen eggs for operating and selling expenses. At the end of the fiscal year a reasonable amount is put aside for reserves, dividend, advertising, etc., and the balance of the surplus, if any, is divided among the members according to their deliveries.

In addition to this, 1 cent per dozen is deducted from the selling price of the eggs handed to the producer, and placed to his credit towards the purchase of further shares. As soon as $10.00 is made up in this manner the producer is given a further share in the society. This procedure will, however, cease as soon as the authorised capital has been paid up.

In times of plenty, the society, at its discretion, places a proportion of the eggs delivered in store, paying the producers at the end of the week at the current market price. When it is considered wise to sell these, the producers generally are

credited with the further profit made, or debited with the loss incurred should storage and insurance absorb the profit. This second transaction is, of course, between the society and those producers only who made deliveries during the week in which the eggs were put in store.

The society has the right to send eggs to any market which it may consider advisable, and in that case is considered to have bought the eggs at the current market value at the time of shipment. The profit or loss on these transactions is, however, credited or debited to the general corporate fund, and not directly to the producers.

This Central Californian Society has not considered it yet necessary to apply co-operative methods to the marketing of poultry, but should it decide to do so, the members, after ten days' notice, are bound to begin delivering their poultry for marketing to the society as they now do their eggs.

These are only main points in an organisation typical of many which exist for the marketing of various agricultural products in California.

It is thought that American methods could profitably be studied by poultry farmers in the United Kingdom. This is not to say that imitation of particular methods is all that is desirable, or that such imitation would, in fact, revolutionise the British poultry industry. The main point is the necessity of business principles in the building up of a prosperous industry. These have been applied with such conspicuous success in the United States, and notably in the district referred to above, that persons interested in the industry would be well advised to make a close study of these principles and the methods to which they have given rise. In particular, the spirit of co-operation and a certain financial courage, when allied with individual hard work and enterprise, would appear to be the main desiderata for success. When it is realised that so compact and successful a community as that of Petaluma has grown up in a State the size of England, but with only one-tenth the number of inhabitants, the possibilities of the poultry farming industry in the United Kingdom, where so tremendous and convenient a market exists, would seem to deserve exploitation to the fullest possible extent.

* * * * * *

SADDLEBACK OR SHEETED PIGS.

SANDERS SPENCER.

THE breeders of this curiously marked pig are probably in a better position than those of any other breed of pig to prove its antiquity and originality, as it is recorded that sheeted pigs were exported from England about one hundred years ago to the United States, where they have proved so successful that it is estimated that its breeders number at least thirty thousand. For many years the saddleback or sheeted pig passed in the States under the name of The Thin Rined Pig, etc., but a few years ago the breeders determined to alter the name of their society to that of "The Hampshire Pig Society." Some surprise has been expressed with the choice of name since it is not considered that Hampshire is one of the principal homes of the saddleback pig, but it probably arose either from the original importation having been made from Hampshire or from the name of an early breeder.

The name adopted in America appears to have given rise to a discussion of the question as to the original home of the Saddleback pig and this again has led to the expression of opinions as to which of the two districts has succeeded in retaining the greater portion of the points and character of the original breed. Before a decision could be arrived at on this point, would it not be necessary to arrive at a conclusion as to whether or not there existed both in the South and in the East a native breed of pigs of a very similar colour and character? If the first importation into the United States came from Hampshire, sheeted pigs were evidently in the South of England at least as far back as the beginning of the past century, and on the other hand we find one of the old writers on pigs stating that "the original Essex pig was a parti-coloured animal, black with white shoulders, nose and legs—in fact a sort of 'sheeted' pig, large, upright and coarse in bone." Another old writer asserts that "there is another improved Essex breed, called the *Essex half black*, resembling that which I have described in colour, said to be descended from the Berkshire. This breed was originally introduced by Lord Western, and obtained much celebrity." Another quotation runs, "Lord Western," according to Mr. Youatt, "was at one time in possession of the best breed of Sussex pigs, therefore it is most probable that he used them to turn the old black

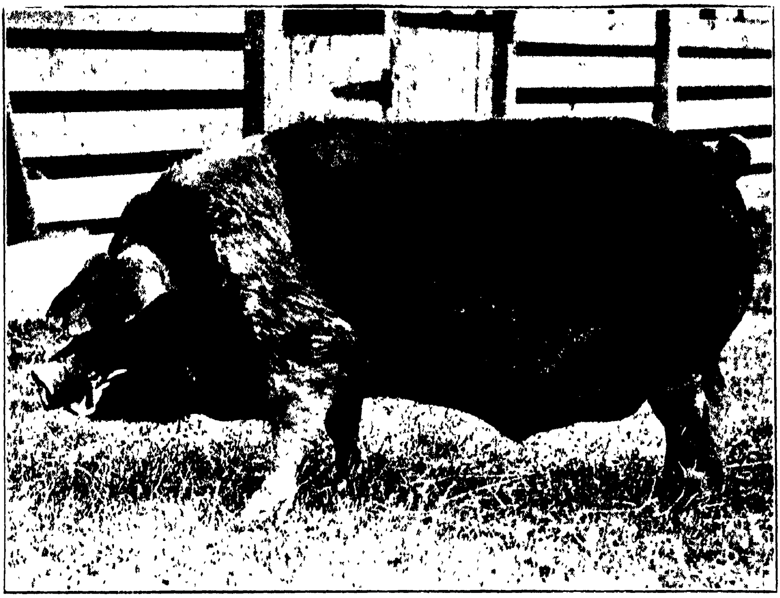

FIG. 1.—A Wessex Saddleback Boar.

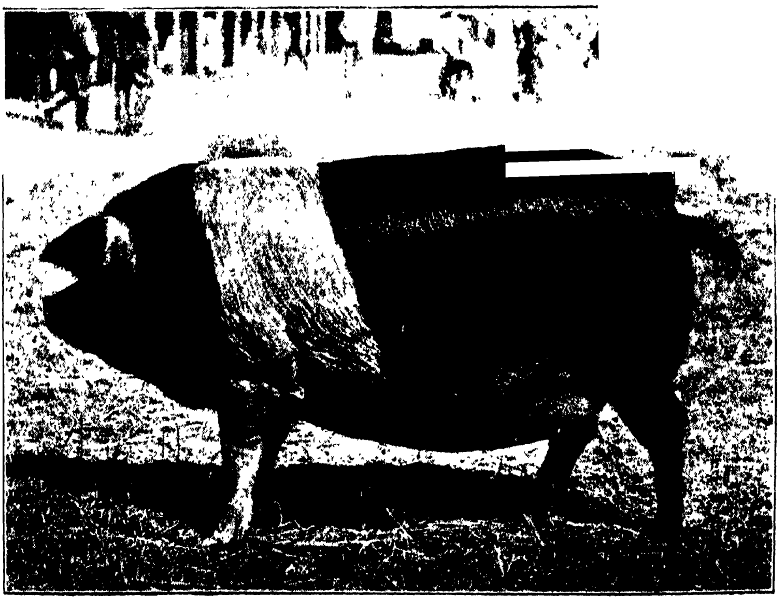

FIG. 2.—A Wessex Saddleback Sow.

FIG. 3.—An Essex Saddleback Boar.

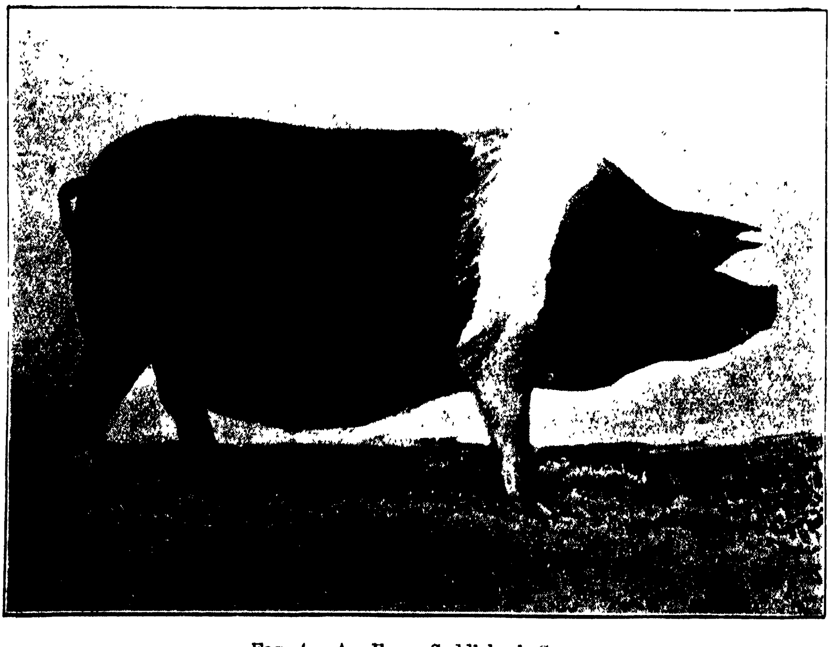

FIG. 4.—An Essex Saddleback Sow.

and white sheeted Essex pigs black." Although the same author gives a description of the Sussex pig of that day—about 1830—he omits to describe the colour of it. However, it is on record that Mr. Western, or as he subsequently became, Lord Western, did purchase sheeted pigs in the South of England in the early portion of the last century and kept them on his estate in Essex.

The sheeted pig was not kept in its purity in Essex to any very great extent during the latter half of the last century, but the persistency with which the sheeted markings appeared in pigs which were admittedly of mixed breeding may be said to prove that the foundation breed of the Essex pig must have possessed many of the characteristics, including the colour, of the sheeted pig as it is known in the Eastern and Southern counties.

There surely must be a sufficient similarity in the form, character and colour of the two types of saddleback pigs to render it advisable that a junction of the two societies should take place, so that the whole of the energies of the breeders of Saddleback pigs, whatever their origin, should be concentrated on the extension of the undoubtedly many good qualities of the sheeted pig. The old saying that a house divided against itself cannot stand, may not be entirely applicable to the present position of two societies to look after the interests of one breed of pig, yet a combination of the best men of the East and of the South must be more pregnant of good than divided councils. It could hardly be beyond the power of a small Committee composed of two or three members of each Society and an independent chairman to devise a scheme which would prove beneficial to all the breeders of Saddlebacks and to the pig itself. It would indeed be a great pity that a breed with so many inherent good qualities should be delayed in its full development by a slight difference of opinion amongst its breeders in different parts of the country as to the value of certain minor points which are of greater fancy than commercial value. If proof were needed of the great value of amalgamation we have it exhibited in the affairs of the Large Black Pig Society. The types of pigs bred in the Eastern Counties and in the South-Western Counties were decidedly different, yet by a combination of the two a breed has been evolved which has more supporters than any other single breed of pig. The breeders of Wensleydale sheep have also admitted the great value of combination by merging the two Flock Book Societies into one.

This continued division of interest and energy would be most unfortunate, as the sheeted or saddleback pig has many

good qualities, particularly those needed in pigs to be converted into bacon of the highest market value. These include fine quality of skin, bone and hair, lightness of forequarters, squareness of hindquarters, and a comparatively long back. Their flesh is also of good quality and possesses a large proportion of lean meat. It is quite possible that these good points will be esteemed of still higher value in the near future if the marked extension of the pig-breeding industry continues, as one of its results will be the production of a considerably increased number of pigs beyond those which are required for the pork trade alone. The surplus will need to be converted into bacon, a purpose for which the sheeted pig is believed to be particularly suited.

The breeders of saddleback or sheeted pigs both in the East and in the South appear to have realised the fact that the requirements of the bacon factor are worthy of the greatest consideration and they have endeavoured to improve their pigs on the lines indicated. It might be advisable if even still further attention were paid to length of body and shape and development of the ham, as these are two of the most important points in the bacon curers' model pig.

Each of the Societies has formulated a Standard of Excellence, that of the Essex Society being as follows :—

Head.—Medium length, broad.
Ears.—Medium size, carried forward, but not flopped.
Neck.—Medium length.
Shoulders.—Broad, but not open, deep, smooth and compact.
Chest.—Deep, full girth.
Back.—Straight, broad and level.
Loin.—Broad and strong, free from slackness.
Ribs.—Well sprung and deep.
Sides.—Deep and full, long and smooth and free from wrinkles.
Flanks.—Full and well let down.
Hams.—Broad and well filled to hocks.
Legs.—Strong, straight, well set, with clean bone, feet medium size.
Tail.—Medium, fine and curled with white tip and well set on.
Hair.—Fine and silky.
Colour.—Black with the exception of white belt encircling the shoulder including forelegs, white hind legs not higher than hock, white nozzle and white tip to tail.
Condition.—Uniform covering of flesh, especially in region of valuable cuts.

Objections:—
Head.—Badger face.
Ear.—Erect or floppy.
Colour.—Blue coloured band between white and black on shoulder. Black hind legs and tail.

The Standard of Excellence of the Wessex Saddleback Pig Society runs :—

Colour.—Head and neck, black, white over shoulders and forelegs, hindquarters and hind legs, black.

Head.—Fairly large and straight snout, face not more than slightly dished, fairly wide between the ears.

Ears.—Medium size with forward pitch, setting well close to the face but well carried, with fine fringe of hair, not too coarse, not too papery.

Neck.—Fairly long and muscular.

Chest.—Wide and deep.

Shoulders.—Wide and free from coarseness.

Heart Girth.—Full, not dropping away behind the shoulders.

Legs.—Strong and shapely, with medium bone.

Pasterns.—Strong and sloping, not too long.

Feet.—Strong and of a fair size.

Back.—Long and straight, not dishing.

Loin.—Strong and broad.

Tail.—Set on high, preferably black, nicely tasselled.

Sides.—Deep.

Ribs.—Well sprung.

Flank.—Thick and well let down.

Quarters.—Long and wide.

Hams.—Broad and full and deep to hocks.

Coat.—Moderately fine and straight, not curled.

Action.—Fine, gay and free.

Undesirable Features, not necessarily disqualifying during inspection period.—Curly coat; coarse mane; crown on back; short or turned up snout; over-heavy shoulders; wrinkled skin; inbent knees; hollowness at back of shoulders; any malformation; colouring white on any part but the saddle. Prick ears; ears unduly floppy or rhubarb-like.

* * * * * *

THE APPLE BLOSSOM WEEVIL.

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University of Bristol.

THE Apple Blossom Weevil (*Anthonomus pomorum*, Linn.), which is annually responsible for much loss in apple growing areas, was mentioned as long ago as 1801 by Knight in his "Treatise on the Culture of the Apple and the Pear" and since that date the writers of almost every decade have had something to say regarding its habits and life history, and have suggested various methods of control. Much confusion, however, existed with regard to its habits and life history, and the ravages of the pest were so marked in 1919 and 1920

that it was thought advisable to spend a considerable time in working out the details and in studying control methods. This work has been in progress at the Agricultural and Horticultural Research Station, Long Ashton, since September, 1920, and the following is a summary of the results.

Life History.—Towards the end of March the weevils leave their winter quarters, and, warmed by the sun, crawl to the smaller branches of apples and pears, and piercing the blossom buds as soon as they show green at the tips, thrust the rostrum, or trunk, downwards towards the growing point and suck the juices. It is at this period that the use of the "V" mark on the elytra is important for the weevils are very much exposed to the attacks of birds. This mark splits up their outline and affords considerable protection as shown at A, Fig. 1, where the weevil fits the colours in with its immediate surroundings. This spring feed stimulates the sexes and mating takes place. Alternate periods of feeding and resting in any available shelter now extend until the blossom buds reach that stage of development known as the "Cluster-bud" stage, *i.e.*, when the first young leaves bend outwards revealing the individual flower buds in a compact cluster (A, Fig. 2). This stage is usually reached within five weeks after the first appearance of the weevils—in 1922 the weevils were first seen feeding on 23rd March and the "cluster-bud" stage was reached by 28th April. Egg-laying now takes place; the female selecting a flower bud proceeds to drill a hole into it with her rostrum which penetrates calyx and petals and scoops a hollow cavity in the anther lobes. This operation takes about ten to twelve minutes, after which the female reverses her position and thrusting her ovipositor into the hole deposits an egg in the prepared cavity in the anther. This takes from one to two minutes. The cavity is not closed up with saliva as was formerly thought but by the congealing of a sappy exudate from the damaged tissue of the calyx. After about eight to thirteen days the eggs hatch and the young larvæ or grubs commence feeding on the pollen cells of the anthers. Feeding goes on for a fortnight to three weeks during which time the anthers, filaments and styles are destroyed, and often the surface of the receptacle is damaged. The larvæ gnaw at the base of the petals with the result that the petals do not open in the ordinary way but dry and form dome-shaped coverings under which the larvæ live. These are known as "capped" blossoms. Several moults

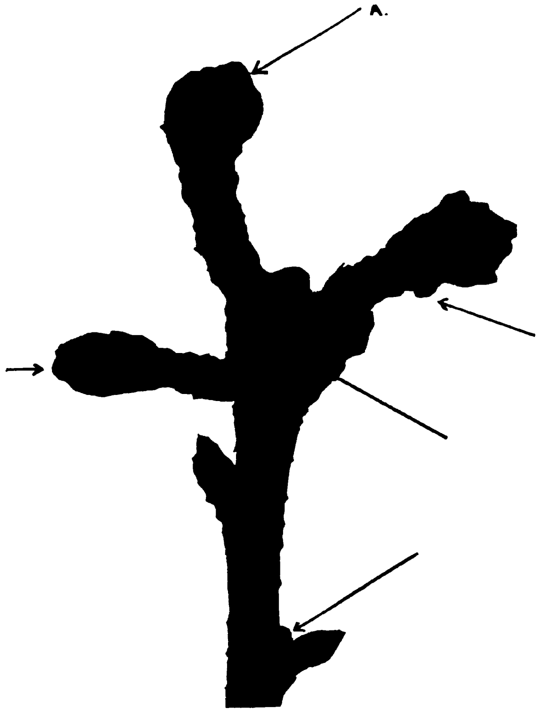

FIG. 1.—Apple Blossom Weevils feeding in Spring. The Branch in Bud-green stage.

FIG. 2.—Typical Canker Spot which would afford Winter shelter to Apple Blossom Weevils. "A," Cluster-bud stage suitable for oviposition.

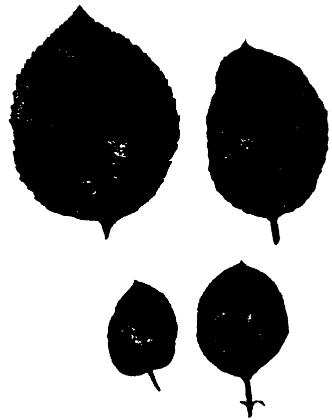

FIG. 3.—Damage to Apple Leaves caused by young adults of the Apple Blossom Weevil.

take place during the larval life and the last of these reveals the pupa or chrysalis, which occupies the capped blossom for about a week, at the end of which period the young adult emerges, and, after hardening up, cuts its way out.

The young adult weevil emerges about the beginning of June in early seasons, but not until the end of June in late seasons, and spends about a month feeding on the under-surfaces of the young leaves of the apple (Fig. 3). It discards the lower epidermis and feeds on the mesophyll or internal leaf tissue leaving the upper epidermis intact. Feeding goes on for from three weeks to a month, at the end of which time the weevils begin to seek winter quarters, selecting the following sites:—

(*a*) Cracks and crevices in the trunks of apple, pear and plum trees and any other trees near the plantations. Canker spots are often selected.

(*b*) Dead leaves, heaps of refuse, and under old grease bands where a paper foundation is used.

(*c*) Hedge bottoms and in the soil.

Certain conditions seem to be necessary in the winter site selected, and the result is that when these conditions are fulfilled large numbers of hibernating weevils may be found close to each other. In Worcestershire, the principal hibernating quarters of the large bulk of weevils in plantations of smooth barked trees were found to be under the paper of old grease bands on both plum and apple trees.

Natural Enemies.—The Apple Blossom Weevil suffers to some extent from the attacks of birds, fungi, and insects. The birds which chiefly take the adult weevil are the woodpecker, tits, nuthatch and chaffinch, while the sparrow is recorded as pecking open the "capped" blossoms and taking the larvæ or pupæ.

At Long Ashton many dead weevils were found during the winter; these had all been killed by a fungus which was apparently a species of *Isaria*, a common insect-attacking fungus.

The principal insect enemy of the Apple Blossom Weevil is an Ichneumon fly, *Pimpla pomorum* (Ratz). The female parasite seeks out the young flowers infested with weevil grubs and therein lays an egg either on or near the body of the grub. This egg hatches and the young parasite, emerging, attaches itself to the larva or pupa of the weevil and proceeds to feed, growing very rapidly at the expense of its host which is finally destroyed. Dr. Imms, of the Department of Plant Pathology at Rothamsted, has shown* that this parasite is recorded as

* Annals of Applied Biology, Vol. IV, 1917, No. 4.

being very efficacious in keeping the weevil in check, and he records it as destroying 27.4 per cent. of the weevil grubs in Cambridgeshire in 1916. Numbers of parasites were reared at Long Ashton in 1921, the parasitism working out at 5 per cent.

Control Measures.—The Apple Blossom Weevil is possibly one of the most difficult of orchard pests to control, and it is very doubtful if any one control measure will, of itself, give any appreciable freedom from loss. In view of this it is probable that several operations should be fitted into the routine work and these will tend to give increasing freedom from attack if followed year after year.

Banding.—This operation consists of tying corrugated paper. ordinary brown paper twice folded, or sacking round the trunks of trees fairly near the crotch. There are two periods in the year when banding is likely to yield good results. The first is in spring towards the end of March and on into April, the period when the weevils alternately feed and shelter. This is important in that weevils caught at this time have not commenced egg-laying. In 1921 Mr. D. E. Tower, of Pershore, tried banding in March and April and quite satisfactory numbers of weevils were caught. It was noticed that the bands sheltered more weevils early in the morning than later in the day and that most of them were located on the south side of the tree. The second period for banding would be from the end of June onward, the object being to supply the weevil with a readily available winter shelter. In 1921 at Long Ashton bands were put on in the middle of June with the result that most weevils were caught during July, August and September, the numbers rapidly decreasing as winter drew on. In this connection it is most important that the bands be in position early, otherwise the weevils may be driven to shelter by an early spell of cold weather and seek shelter out of range of the growers' treatment, *e.g.*, in the bark of neighbouring trees such as oak and elm.

The bands may be examined about once per week in the case of the summer banding, but in the spring they need to be examined every morning as the weevils are very restless and move about from place to place on the tree during the day.

When the bands are removed the greater number of weevils will come away attached to them and can be shaken off into a bucket containing paraffin. Some weevils, however, may be

left behind on the bark; these should be either crushed or brushed off into the bucket.

Jarring.—This is a practice in favour with some growers who claim to have had good results by its employment. It is based on the fact that the weevil when in the tree will fold its limbs in close to the body and fall at the least shake or jar. Observations show that in spring at the first feeding period and until about half-way through the oviposition period the weevil is very responsive to jarring on bright warm windless days, but on cold days or windy days it will secrete itself between the cluster of young flowers and the leaves and no amount of jarring will induce it to fall; moreover, from about the middle of the egg-laying period the females are so busy egg-laying or resting that they will cling to the buds in spite of violent jarring.

One feature of jarring on ideal days is that the sun renders the weevils very active, so much so that they readily take wing, and numbers, having been jarred off and finding themselves falling, spread their wings and fly back into the branches.

Where a plantation lends itself to jarring, padded mallets or other strikers should be used and, to catch the weevils, a wide tarred sheet with a cut giving access to a circular opening in the centre for the reception of the trunk.

Spraying.—Spray treatment, as advocated from time to time, aims at:—(1) poisoning, (2) killing by contact, or (3) having some mechanical action.

The fact that, in the spring feed, in boring the holes for egg-laying, and in feeding on the under surfaces of the leaves, the surface tissue, *i.e.*, the tissue that would be coated with any adherent poison, is rejected at once shows that little good can be expected from poisons such as lead arsenate; it is not surprising, therefore, that trials at Long Ashton yielded very unsatisfactory results. Nicotine has often been suggested as a spray but has only an anæsthetising action, the weevils quite recovering shortly after treatment.

Several caustic soda sprays and other winter washes were quite unsuccessful in laboratory trials conducted by the writer: where lime-wash was used, in an attempt at sealing the weevils up in their winter quarters, though made and applied under ideal conditions, it proved most unsatisfactory, the weevils coming out to feed quite covered with the lime wash.

The spray which yielded the best results at Long Ashton was an unstable paraffin emulsion. Numerous trials with different proportions of the mixture, were made, the greatest measure of success being obtained with:—

Potash soft soap ... ... .5 per cent.
Paraffin ... ... 10 per cent.

The fact that paraffin readily comes out of this emulsion is a drawback to its use since it necessitates the mixture being kept agitated while spraying, but the instability is essential since it is by the paraffin that the insect is killed. The difficulty is overcome where a good mechanical agitator is used. The spray kills by contact and therefore needs to be applied only to those situations on the tree where the weevils are likely to be wintering. Canker spots, crevices, growth cracks and rough bark should be well drenched and a good force kept behind the jet. Where well wetted with the spray the weevils are killed within a quarter of an hour. For ordinary bush trees on paradise stocks, and reaching a height of about 6 ft., one gallon of the spray is sufficient for about three trees. For young and small trees a Knapsack spraying outfit would probably be found quite satisfactory. The spray should be applied towards the end of March.

Where lime-sulphur is used annually as an insurance spray a peculiar dry condition of the rough bark and crevices arises, and this condition is such that the sites are quite unsuitable as winter quarters for the Apple Blossom Weevil. This suggests that where the use of lime sulphur is regularly followed good results might be obtained by banding.

In addition to the treatments indicated, measures that will tend to make for an increasing freedom from the pest are keeping the trees clear of rough bark, mosses and lichens, and observing the rules of clean husbandry in the plantations.

Where practicable, as indicated in the leaflet on the Apple Blossom Weevil issued by the Ministry of Agriculture, collecting the capped blossom, destroying the weevil and liberating parasites are measures which, if followed systematically, may have very far-reaching results in controlling the weevil.

At present it is advisable that where great losses occur annually the methods herein indicated should be used either in their entirety or else modified to suit the particular circumstances. No one method is likely to give complete control but where two or three are employed in conjunction in plantations a reasonable freedom from this pest is obtainable.

SPOTTED MEDICK.

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THE presence of Spotted Medick (*Medicago arabica*, All.; *M. maculata*, Sibth.) in scattered patches on the Seale-Hayne College Farm, and on other farms in the district early in 1920, led to the plant being very closely observed. During 1920 a certain amount of damage was done to hay and also in pastures. In

FIG. 1.—Spotted Medick as it appears in Meadow Land.

1921 the exceptional drought burned up all pasture and destroyed much plant life. When the drought broke, Spotted Medick was the first plant to recover; it grew rapidly and has since spread considerably. The possibility of further spread

and damage was obvious, and some means of eradication had to be found. Experiments on eradication were carried out and some success has been achieved.

Description.—Spotted Medick (see Fig. 1) is a herbaceous annual occurring by waysides, in natural grass lands, and in pastures. The numerous stems spread over the surface of the ground and only seldom assume an erect position. The leaves are trifoliate and usually each leaflet has a dark purple spot in the centre. The leaves are at first light green, and become darker after flowering. The prolongation of the leaf stalk, as in all medicks, projects beyond the stalks of the two side leaflets carrying with it the terminal leaflet. The small yellow flowers occur in pairs or a few together. The fruit consists of a spirally coiled pod, the edges having a double row of long curved spines, and the seeds are of a sulphur yellow colour.

Distribution.—Spotted Medick is a native of Western and Southern Europe, Western Asia, and North Africa. It is found generally in Central and Southern England, and occurs in certain districts of Devon. It is most readily observed along the roadsides, hedges and banks, but particularly in the neighbourhood of farms and frequently near the farm buildings. Its vivid green appearance and luscious growth at once mark it out from the rest of the vegetation.

In Cornwall, where it also appears, a curious story of its introduction to that county still survives. A ship with a cargo of Australian wool was wrecked off the coast. The wool was washed ashore and much of it scattered and carried by various means on to the land. As a result Spotted Medick gained a footing and since then has spread through the county. Although such an isolated case would not affect the whole country, yet wool may play a very large part in the introduction of seed to the land.

Life History.—The plant generally appears in the early spring, flowering, fruiting, and dying down, a second generation growing up during midsummer and again dying towards autumn. In the mild weather of the south-west it may succeed in setting seed more than twice. Three generations per annum are the maximum, but two are more common. In pasture or on arable land the number of generations in a year depends largely on circumstances such as weather, the closeness of grazing, the crop and cultivation. A plant so prolific can obviously spread with great rapidity if conditions are favourable.

Arable.—On arable land Spotted Medick seldom becomes a serious pest except through the spread of the fruits to neighbouring fields. In root crops cultivation kills it, in cereal crops it seldom grows to any extent, being crowded out. In hay, however, a different case arises. The rapid growth of the Medick enables it to outgrow grasses. Its rather prostrate growth shades the leaves of the young grass and even where a few plants do succeed in sending leaves through its dense mass of foliage, the grass is frequently borne down by the pressure and weight of the Medick. Should the season be a wet one, the Medick becomes heavy with rain, weighs down the grasses, and if it has reached the fruiting stage, the whole mass rots. In the summer of 1920, a small field of about one acre in extent was left for hay. At harvest time half of the total

FIG. 2.—Spotted Medick as it appears in Pasture Land.

crop was lost, owing to the Medick crushing out most of the grasses, weighing down the rest and finally rotting. So far none of the large fields have been affected to any great extent, but should Medick again appear extensively the result may be a serious loss.

In Grass Land.—In pastures the Medick problem is still more trying. Here Medick will be cropped to a certain extent and it assumes a very dwarfed habit of growth not unlike wild white clover, except that the leaflets are very broad at the tip with a slight notch (see Fig. 2). The purple spots under such circumstances often do not develop. In this state Spotted Medick is by no means easy to detect. It crowds out practically every other plant, and several patches last

spring, where wild white clover was plentiful, are now, owing to the drought, a complete carpet of Spotted Medick. A pasture where Spotted Medick is present will show bare patches at a time when the rest of the pasture is quite green. This is due to the fact that the Spotted Medick has completed its life cycle, and has set seed. An examination of the ground will reveal a plentiful amount of the "burrs" or fruit. A few weeks will elapse before the next generation of Spotted Medick arises and meantime the patch, which may have an extent of some square yards, becomes crowded with weeds. As in hay, so in pastures, before they are finally crowded out, the weeds succeed in maturing their fruits and these are dispersed to the detriment of the pasture.

Information has just been received that Spotted Medick is causing considerable trouble in certain pastures in the Isle of Wight. It is stated that stock readily graze the Spotted Medick till in flower, but after that stage refuse to eat it.

Method of Distribution.—The spread of Spotted Medick on the farm is very easy. The double row of hooks on the edge of the twisted pod cause it to catch in the hair of animals. In the case of sheep it catches in the wool and is most difficult to remove. The difficulty, however, is not its spread within a certain area, but its presence in quantity in certain areas and not in others. Spotted Medick is found fairly frequently in some localities while the plant in others is unknown. Until coming to Devon, the writer had never seen the plant, and the fact that it occurs plentifully only in certain places seemed peculiar. Shortly after this, specimens were received from Kent, where it has been a pest in orchards and was spreading; there the source of the outbreak was said to be shoddy. Some time later a sample of cleanings obtained from a wool mill was found to be filled with the fruits or burrs. Finally, a visit to a wool mill in Devon completed the story. The skins of sheep with wool complete, were received from South Africa and Australia, packed in large bales. Every bale examined contained a plentiful supply of the burrs of Spotted Medick. Several of the older workmen stated that the burrs came with the wool from Australia many years ago, but not in that from South Africa. Later some sheep from Australia were imported to South Africa, and soon the burrs appeared in the wool of the South African sheep, and now it often contains more than the Australian wool. The washings of the wool and the cleanings contain a marvellous assortment of fruits and seeds, in-

cluding a very high proportion of Spotted Medick. This refuse is used by many farmers and put on the land and explains the occurrence of Spotted Medick in large quantities in certain localities, while it is absent in others, although soil and situation are similar.

Eradication.—Spotted Medick being an annual, eradication is largely a question of destroying the foliage at an early stage. Two methods are possible, wet and dry spraying. The time of application of the spray and the conditions are most important. For both wet and dry spraying the weather must be dry, sunny and the air still. Wet weather or moisture minimises the effect of the chemical used, while sunshine helps considerably. The effect of the dry spray is to scorch the tissue of the leaf, and finally to destroy it.

To test the various chemicals used, only small plots 8 sq. yd. were treated, and the result of these used for trial on a larger scale. The sprays used were as follows :—

Wet Sprays.		
Copper Sulphate ...	2 per cent. solution	failure.
Caustic Soda ...	2½ " " "	failure, unless a very large quantity used when grasses were seriously damaged.
Sulphate of Ammonia	5 " " "	failure.
Dry Sprays.		
Kainit.		
	10 oz. per 8 sq. yards	not satisfactory.
	5 " " " " "	failure.
Nitrate of Soda.		
	10 oz. per 8 sq. yards 5 " " " "	stimulated growth of Medick.
Sulphate of Ammonia.		
	12 oz. per 8 sq. yards. 10 " " " " " 9 " " " " " 8 " " " " " 7 " " " " " 6 " " " " " 5 " " " " "	all gave good results. The smaller quantities were slower acting.

The sulphate of ammonia plots were the only successful ones and they were repeated with the same result. The larger applications showed quicker results, but the final result was the same provided the distribution of the powder was carefully done over the area under treatment.

The result is most unsatisfactory when the weather is wet. Sunshine is also an additional advantage. Even if the weather

is dull and the atmosphere moist the result will be good, but the spray will require a longer time to act. The early spring is the best time for spraying, particularly when the leaves are fresh and tender.

The result of treating with sulphate of ammonia will be evident within three days or less, depending on conditions. By the end of a week, if there is a large number of Medick plants present, the area treated will be recognised by the brown colour due to the withering of the Medick and the consequent bare patches of soil. Shortly after this the grasses exhibit vigorous growth and in a few weeks the areas become green unless weather conditions are adverse. It may in some cases be necessary to sow a little seed on the bare patches, especially if there are weeds present, which will usually have been destroyed at the same time as the Medick.

As only areas in a pasture will need treatment, the sulphate can easily be applied by hand, or, if it is decided to treat the whole field, a manure distributor can be employed. Sulphate of ammonia possesses a double advantage as it not only destroys Spotted Medick, but at the same time stimulates grasses of the best quality. Hence the treatment is not a case of spending money only on the eradication of a weed, but of manuring the pasture which will give a return for the money spent on the manure and its application.

* * * * * *

CONCILIATION COMMITTEES: A YEAR'S WORK.

IT is now twelve months since the machinery for the compulsory regulation of wages in agriculture by the Wages Board was replaced by the present system of voluntary Conciliation Committees, and it may be of interest to review the progress of the Committees up to date.

Constitution.—Under the terms of the Corn Production Acts (Repeal) Act the members of the District Wages Committees of the Agricultural Wages Board became Interim Conciliation Committees pending the formation of permanent Committees. The Act avoided laying down any hard and fast lines as to the constitution of the Conciliation Committees, the only stipulation being that they should be composed of representatives of persons (whether owners or occupiers of agricultural land) employing

workmen in agriculture and of such workmen. As was anticipated, in several cases local feeling was in favour of forming Committees for smaller areas than had existed under the Wages Board and in consequence the 39 District Wages Committees have been replaced by 61 Conciliation Committees. In 26 cases the original areas have been retained but in certain cases where sub-division has taken place, as many as five separate Committees have been formed for a single county.

Under the Act an Interim Conciliation Committee can hold office until the 19th August, 1923 (*i.e.*, two years from the date of the passing of the Act), but nearly all the Conciliation Committees have now adopted some form of permanent constitution. A suggested form of constitution has been supplied by the Ministry providing *inter alia* for the regular retirement of a proportion of the members and for their re-election. Fifteen of the Committees have taken advantage of the Clause in the Repeal Act enabling them to appoint an independent chairman (without power to vote). In the majority of the other cases the chair is occupied alternately by a leader of each side.

Wages Agreements.—Although the Agricultural Wages Board did not expire until the end of September the Ministry had suggested that the Interim Conciliation Committees should meet well before that time in order to agree on rates as from the 1st October and thus avoid a break in continuity, and in spite of all the difficulties in the transition to a completely new system, more than half of the Committees were able to reach provisional agreements accordingly. Most of these agreements were for a short period only—many of them simply prolonging the operation of the rates as left by the Wages Board. In other cases, however, wages were immediately reduced by 2s. to 4s. from the 42s. of the Wages Board.

By the end of October considerable progress had been made, agreements having been reached in 29 of the 53 areas for which Committees had been formed by that date. The average rate of wages for adult male workers by the end of November had fallen to about 38s. At the end of the year the number of Committees had increased to 57, of which 40 had made agreements at one time or another, 31 agreements being current at that date. Most of the agreements had been made for only short periods and were due to expire at the end of the year, but no difficulty was found in arranging further meetings of the Committees and it was becoming realised that for the interests of both sides agreements should be made for reasonably long periods. An excellent lead

was given to the Committees in this respect by the agreement reached by the Northamptonshire Committee on the 16th January, the agreement being made to cover the whole of the farming season to the beginning of October. Certain Committees, however, have preferred to avoid fixing a definite period to their agreements but have made them for undefined periods with a proviso for termination on specified notice by either side.

Taking the year as a whole, 55 out of the 61 areas have made agreements, there being 6 areas in which, notwithstanding frequent meetings, no agreements have been reached. About 40 agreements have been for periods of 5-6 months (or more).

Average Wages.—With the falling prices of farm produce and the drop in the cost of living, the tendency of wages throughout the year has been downwards. Owing to the variations in hours and overtime and the absence of agreements in certain areas, only an approximate estimate of average wages for the country as a whole is possible, but taking the agreed rates in the various areas on a weekly basis and making allowance for the prevailing wages in areas without agreements, it is estimated that average weekly wages of ordinary adult male workers have varied as follows:—

1921.	s.	d.	1922.	s.	d.
August ...	46	6	January ...	33	6
September ...	42	6	February ...	33	0
October ...	40	0	March	32	6
November ...	38	0	April—August	32	0
December ...	37	0			

The figure for September, 1921, is the minimum rate of wages as last adjusted by the Agricultural Wages Board and that for August, 1921, represents the average minimum rate in force during the previous 12 months. It will be seen that the average wage in August, 1922, had fallen by 14s. 6d. or about 30 per cent. from the minimum rates ruling during the last year of the Wages Board's existence, but that taking into consideration the last reduction made by the Wages Board, wages have fallen only 10s. 6d. or 23 per cent. during the period of the actual working of the Conciliation Committees. The Ministry of Labour's cost of living index figure on 1st August, 1921, was 122 per cent. above the 1914 base, and had fallen to 81 per cent. on the 1st August, 1922, *i.e.*, a decline during the year of about 18 per cent.

Space does not permit of a full record of the various rates which have been fixed by the Conciliation Committees within the last year, but although the weekly wage in the period April-

August of this year is estimated at 32s. for the country as a whole, wages in the different localities vary considerably above and below this figure. In the Northern group (Northumberland, Westmorland, Durham, North Riding, Cumberland and Lancs.), for example, the average wage is about 34s., whereas in an Eastern group (Norfolk, Suffolk, Cambridgeshire, Beds., Hunts., and the Isle of Ely) it is only 31s.

The following table compares the rates in the areas where the highest and lowest rates have been fixed :—

	Committee.	Rate.
High Rates.		
Winter, 1921–22...	Lancashire (average)	47/6 for 60 hr.
	Durham	44/6 " 50 "
	S. Northumberland	44/6 " 48 "
Summer, 1922 ...	Lancashire (average)... ...	43/4 " 60 "
	Durham	35/– " 50 "
	S. Northumberland	32/– " 50 "
Low Rates.		
Winter, 1921–22...	Sussex East	31/– " 52 "
	Dorset	32/- " 48 "
	Brecon and Radnor	34/– " 50 "
Summer, 1922 ...	Anglesey	30/– " 56 "
	Cumberland and Westmorland	30/– " 54 "
	Wiltshire	30/– " 52 "
	Norfolk	30/– " 50½ "
	Kent, Hereford, Oxford, Rutland	30/– " 50 "

Comparing the " highest rates " areas in the above table it will be found that the average weekly rate fell from 42s. 11½d. last winter to 37s. 9d. during the summer of this year. Owing to the varying periods of agreement in the " lowest rates " areas it is not possible to make a similar calculation for the counties given in the table, but for such " low rate " areas as are comparable, *e.g.*, Shropshire, Warwick, Devon, Somerset, the average rate fell from 34s. 7½d. last winter to 31s. 7d. in the summer. Thus the average decrease from winter to summer in the high rate areas is about 13 per cent. as against 9 per cent. in the low rate areas.

Ages and Classes of Workers covered by the Agreements.— Generally, the main agreements made by the Conciliation Committees refer to all male workers over 21 years of age, but in certain areas the Committees have stipulated that the rates shall apply only to " able-bodied workers " or to workers " of fair average ability," while in Surrey there is an upper age limit, the rates not applying to men over 65 years of age. In 5 areas the Committees, in addition to fixing rates for ordinary workers, have fixed special rates for stockmen, shepherds, etc., by which

such workers receive an inclusive wage to cover their extra time worked in connection with the care of animals.

In only 28 areas have agreements been made containing special arrangements for workers under 21. These rates are usually based on a proportion of the adult workers' rates according to the age of the worker. It is understood that in the areas where no agreements have been made for juvenile male workers this basis of payment is usually applied, the actual details being left for mutual agreement between workers and employers. Only 6 Committees have fixed rates for female workers, most of the areas concerned being in the North (Cumberland and Westmorland, Northumberland and Durham), where it is more usual than elsewhere to employ full-time women workers, but women's rates have also been agreed for Nottinghamshire and Devonshire.

Hours of Work.—Apart from actual wages one of the most contentious matters with which the Committees have had to deal is that of hours, and in the East Riding of Yorkshire and in one or two other areas serious trouble arose on this issue. In nearly half of the areas where agreements have been made the 50-hour week in summer has been retained, but in 11 areas the agreements provide for a week of 54 hours. In Lancashire the weekly rate is stated to cover the "usual" working hours.

Several Committees have fixed wages on an hourly instead of a weekly basis but in the great majority of these cases the worker has a guaranteed week of a specified number of hours. In Brecon and Radnor for example, where the wage-rate is 7½d. per hour to operate up to 60 hours before the overtime rate is payable, there is provided a guaranteed week of 52 hours.

A number of the Committees have not fixed any special rates for overtime: only 35 of the current agreements deal with this.

Benefits and Allowances.—In the earlier months there seems to have been a feeling that the system of benefits as fixed by the Wages Board should be continued. There appears now, however, to be a growing tendency amongst the Committees, except perhaps in Wales and the North of England, to confine their attention more and more merely to making agreements for a cash wage, and to leave all questions of benefits and allowances for settlement between individual workers and employers. In the early months many Committees dealt with the benefits question, but of the current agreements only 6 include clauses fixing valuations for the provision of board and lodging. These areas are, of course, those where a large proportion of the

workers live at the farmstead: Cumberland and Westmorland, Durham and Nottinghamshire, and in Wales (Anglesey, Carnarvon, Denbigh and Flint). In 5 areas the Committees have arranged a valuation for the provision of a cottage. In Pembroke 2s. 6d. per week is allowed as a deduction from wages on this account, while in Stafford and Nottinghamshire the sum has been fixed at 3s. The 2 Northumberland Committees dealt with the matter very fully, and have agreed that the provision of a house and garden, coal leading and potatoes shall stand as payment for all stable time. Nottinghamshire has also met the "allowances" question in a practical fashion by arranging that the provision of milk shall be reckoned at the local wholesale price. Incidentally, there is no other area at present which has fixed a valuation for milk. Nottinghamshire has also agreed that the local wholesale price shall be regarded as the valuation for the provision of any potatoes. Under the Pembroke agreement planting potatoes and the haulage of fuel is regarded as equivalent to part payment at the rate of 1s. per week.

Half-holidays.—The observance of a weekly short-day, which has been strongly urged by the labour side, has not been seriously resisted, the Committees agreeing in general that where the workers desire the half-holiday the employers should facilitate the arrangement of the working hours as may be necessary. Of the current agreements, 13 make definite provision for the observance of the weekly short-day, and it is understood that in many other areas an arrangement exists for ceasing work earlier on Saturdays or for casual holidays to be given in lieu.

Although the individual Committees are responsible for the form of the agreements, the Ministry has prepared the skeleton form of agreement shown below. The form is not intended to be exhaustive but it may be of interest as indicating the points most generally dealt with :—

SPECIMEN FORM OF WAGES AGREEMENT FOR CONCILIATION COMMITTEES.

1. The minimum rate of wages for adult male workers employed in agriculture in the Committee's area shall be not less than /- for a week of hours (excluding Sunday).

2. All time on weekdays in excess of hours per week to be paid for as overtime at the rate of /- per hour.

3. All work on Sundays to be paid for at the rate of /- per hour.

4. The daily hours of work to be so arranged as to enable each worker, if he so desires, to have a weekly half-holiday (either on Saturday or some other week-day if more convenient to the work of the farm).

5. The rates for boys to be as follows:—

	Weekly Rate (for a week of hours) or d. per hour.	*Week-day Overtime.*	*Sunday Work.*
Workers aged 20 to 21			
" " 19 " 20			
" " 18 " 19			
" " 17 " 18			
" " 16 " 17			
" " 15 " 16			

6. In the case of a worker boarded and lodged by the employer, the latter shall be entitled to make a deduction from the weekly cash wage on that account. The deduction in the case of adult male workers provided with full board and lodging to be per week, and proportionate sums in cases where only part board or board only without lodging is provided. The deduction in the case of male workers under 21 and of female workers to be less in proportion to their wages.

7. The above rates shall not apply to those who are not able-bodied, or who are mentally deficient.

8. This agreement is to operate from the..1922, to the....................................1923.

Signed on behalf of the Employers' Representatives—

....

Signed on behalf of the Workers' Representatives—

....

Date...

Any question arising in connection with this agreement should be addressed to the....................................Conciliation Committee, the Joint Secretaries of which are.. (Employers' Side) and...(Workers' Side).

Harvest Work.—In Essex, Anglesey, Suffolk, Norfolk and the East Riding, the Committees settled special rates for harvest work either by the payment of increased hourly rates or on the " seeing it in " basis, while in certain other areas it is understood that arrangements have been made for the payment of a harvest bonus as usual in accordance with the local custom, but with a reduction in the scale commensurate with the fall in ordinary wages.

Observance of Agreements.—From inquiries which have been made by the Ministry's conciliation officers and by the District Commissioners it is quite clear that the rates agreed by the Committees are generally being well observed. Isolated cases of non-compliance have been brought to the Ministry's notice, but except in the cases of non-union farmers, the employers' side of the Committees have generally been able to persuade defaulters to comply with the Committees' decision.

In their power under the Corn Production Acts (Repeal) Act of making their agreements legally binding on all employers

in the area by submitting the agreements to the Minister for confirmation the Committees have, if the necessity arises, an effective method of dealing with employers who will not abide by the terms agreed by their representatives on the Committees. So far only 5 Committees (Cambridgeshire, Isle of Ely, Surrey, Warwickshire, Denbigh and Flint) have taken advantage of the provisions of the Act in this respect.

The majority of the present agreements are now due to expire, but many meetings have already been arranged by the Committees and it is hoped that fresh agreements will be made very shortly.

Recent Changes.—During the past month a long agreement has been reached by the South Middlesex Conciliation Committee. The Committee's previous agreement which was due to expire on the 2nd September, 1922, has been extended to the end of that month and a new agreement made covering the twelve months October, 1922, to September, 1923. The new agreement provides for a rate of 7½d. per hour for adult male workers, which in the case of ordinary workers is to apply up to 50 hours per week with a guaranteed week of 48 hours, and in the case of special classes of workers (such as stockmen) to apply for 60 hours per week. Provision is also made for overtime rates of 9d. per hour on weekdays and 10d. per hour on Sundays.

The fact that this Committee has been able to arrange wages in advance for the whole of the farming year 1922-23 marks an important development in the work of the Conciliation Committees.

Agreements have also been reached in Derbyshire and Nottinghamshire, the Committee for the former area agreeing to the payment of 7d. per hour for all hours worked on weekdays, and 9d. per hour on Sundays until 31st December. In the Nottinghamshire area the rates agreed are 30s. for 52 hours, with 8d. per hour for overtime on weekdays and 9d. per hour on Sundays until 28th February, 1923. The Nottinghamshire Committee has also arranged rates for male workers under 21 years of age and for female workers of all ages, and has drawn up and accepted a scale for the provision of allowances.

Notice has been received from the employers' sections of the Surrey and Cambridgeshire Conciliation Committees to terminate as from the 30th September and the 6th October respectively the current confirmed agreements of these Committees. It may be presumed that this step has been taken to clear the path for consideration of revised rates of wages.

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THE FARM WORKER IN SCOTLAND.

PERMANENT male farm workers in Scotland may be classified as follows:—(1) stewards, grieves or foremen, (2) ploughmen, (3) cattlemen, (4) shepherds, and (5) orramen, including all workers not in charge of animals, and as a general rule a further distinction must be made between married and single workers. Married farm workers are treated as a separate class from the single men and lads. The most important class of worker is the married ploughman, whose wages and allowances and hours of work usually determine the corresponding earnings and working hours of the other classes.

Practically the whole of the farm work is performed by the regular farm staff. A few casual labourers are employed at busy seasons, and during hay time and harvest and for potato planting and lifting many women and children are temporarily engaged.

Housing.—Almost every moderate-sized farm is provided with one or more cottages, which are generally occupied by married men on the permanent staff of the farm. A farm worker's son working on a farm with his father is frequently hired under the "double hinding" system, common in the south-western counties, and unless he can find accommodation in the family cottage, is housed in a loft or attic in the farm buildings, but more often with other single men and lads in a separate room, or cottage with one or two rooms, known as the "bothy." Generally, arrangements are made for meals to be cooked in the farm houses and for the bothy to be cleaned up by a woman once a week. Sometimes, however, the men and lads make their own arrangements and take turns to perform their own cooking, make beds, light fires, and tidy and clean up. Women workers who do not live at home with their parents are usually lodged and boarded in the farm house.

Period of Engagement.—In the greater part of the country the married men are engaged for the year, the term extending either from the 28th May (Whit Sunday) or the 28th November (Martinmas). The half-yearly term is popular in some districts, but mostly amongst single men who are less willing to bind themselves for the whole year. There are very few weekly engagements—excepting amongst the few casual workers—and even women workers are usually engaged on yearly or half-yearly contracts.

Hiring.—Vacancies are usually filled as the result of inquiries or by advertisements in local newspapers. Most of the new engagements which take place each term are made by private bargaining, the basis of agreement being on the lines advised by the organisations of employers and workers. The hiring fairs are still well recognised all over the country, but they are used mostly as occasions for bargaining between farmers who have not succeeded in filling all their vacancies and workers who have been unable to obtain employment by other means. Almost every market town of any importance has its recognised hiring-fair day every half year, on which occasions it is usual to grant a holiday, without deduction of cash wages, to the whole staff of the farms in the neighbourhood.

Allowances.—In most counties there is a customary scale of allowances, but often the individual worker makes a bargain on a different scale according to the circumstances of his family. As an almost universal rule, the married ploughman is provided with a cottage on the farm, free of rent and rates. Except in a few counties a liberal supply of oatmeal forms an important addition to a worker's wages, the quantity varying from county to county, but the average being, at the time of the last inquiry, about 65 stones per annum. Perhaps the most valuable allowance, however, consists of the fairly liberal supply of milk usually provided to the farm worker's household. In general, the married ploughman receives a daily supply of fresh milk all the year round, sometimes as much as 4 pints per day in the summer; a reduction to about 3 pints being made in the winter months. In some areas it is not uncommon for the married ploughman to be allowed the keep of a cow, but in other districts the milk allowance itself has died out, although the workers are sometimes allowed to purchase milk at reduced prices. Potatoes or the produce of an allowance of potato ground are almost universally provided in part payment of wages. Coal is a common allowance in the counties north of Perth and Forfar, and in a few counties 1 or 2 loads of firewood are provided. The provision of free cartage of coal, firewood and flitting, reckoned as equivalent to from £1 to £4 per annum, is quite general. The allowances to single men are on the same basis, but the quantities provided vary greatly, the workers living in bothies being the most generously supplied.

Wages.—The total weekly wages of farm workers depend to a considerable degree on the quantity and the value of allowances provided. In addition they depend on the experience and ability of the worker and the nature of the occupation.

Hours.—As a general rule, throughout Scotland the working hours of the whole of the farm staff, with the exception of the cattleman and shepherd, are practically regulated by the hours of the ploughman. The stable work of the ploughman is considerably less for three or four months in summer when the horses are put out to grass, but the amount of time spent on stable work may be taken on the average to be about 7 hours a week. This means that, except for cattlemen and shepherds, ploughmen usually perform 7 hours per week more than other workers. The Sunday duty and in cases the Saturday half-holiday duty are generally performed in turn on farms where more than one ploughman is employed. The general working day for ordinary workers throughout Scotland during the summer before the War was recognised as 6 a.m. to 6 p.m., with 2 hours off at dinner time. During the four winter months it was usual to work from dawn to dusk with an hour's interval at mid-day—roughly from 7.30 to 4.30. On most farms the working hours on Saturday were the same as on other days, but in some parts of the country it was becoming customary to stop work at 4 p.m. or 3 p.m. and sometimes at 1 p.m. For the greater part of Scotland the pre-war working day may be reckoned as 35 weeks of 60 hours and 17 weeks of 48 hours' average, to which for the ploughman must be added 7 hours per week for stable work. No overtime was paid for any excess hours, and the only general holidays were New Year's Day and one or two hiring-fair days.

The Farm Servants' Union which before the War had already obtained some measure of success in reducing the length of the working day, suspended its activities in this direction during the War, but after the Armistice this body met in conference with the National Farmers' Union of Scotland. As a result working hours were in many districts agreed on the 9 hours per day basis for 42 weeks, 8 hours per day for 6 weeks in the short days in winter, and 10 hours per day for 6 weeks in hay time and harvest, with overtime to be paid after 10 hours have been worked on any day.

The 1919-20 Report of the Board of Agriculture for Scotland states that in general, farm work is now based on the 9-hour day and commences either at 6 a.m. or 7 a.m., and finishes at

5 p.m. or 6 p.m. according to the season, with 1 hour, 1½ hours, and sometimes 2 hours for dinner. In winter the working day is from dawn to dusk with an hour's interval. Frequently a half holiday is given on Saturdays and in many instances farmers are allowing 14 days' holiday each year. Taking an average throughout the country, the ploughman's working week is about 50 hours besides about 7 hours' stable work, which shows an average reduction of about 5 hours a week compared with pre-war working hours. Cattlemen's hours vary according to the number of stock and the period of the year. The Report states that when the cattle are under cover the usual hours are about 9-10 per day in addition to Sunday duty. It is not possible to fix the working hours of shepherds, which vary from a few hours daily supervision of the flocks when all conditions are favourable, to 12 hours and upwards per day during lambing, dipping and clipping time or during periods of disease. The hours of orramen and permanent women workers are usually the same as those of the ploughmen, except that they have no stable work. At present, however, there appears to be a general tendency to increase the length of the working day.

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LESSONS OF THE IMPERIAL FRUIT SHOW, 1921.

IN view of the near approach of the 1922 Imperial Fruit Show the moment is opportune for a short account of the score-card marking by the Judges of the exhibits submitted at the Show last year, in order that intending competitors may have an opportunity of studying the various points before they pack their produce for competition at the Show this year.

The Schedule in 1921 was drawn up to meet the needs of the commercial grower: but while the rules were so framed as to induce the grower to exhibit packages of fruit similar to those ordinarily sent to the market, it was naturally expected that the sample of fruit and the manner of presentation would be above the average. The Show then was important as an educational movement tending to improve the existing methods of grading and packing fruit for the market.

It must be remembered that the grower seldom sees his produce in the market, and his success in grading and packing can only be judged by him from the prices which he receives for the same fruit presented in different ways. This method

of measuring results is clearly unsatisfactory because of the fluctuations of the market and the many factors which influence the price obtained. At the Imperial Fruit Show, however, growers were able to see their boxes of apples staged alongside those sent from other parts of the country and to compare the results of their efforts with those of others. The comparisons in some cases were pleasing, in others less so, but in the latter cases the road for improvement in the future was clearly evident to those wishing to see and travel along it.

But the comparison of the boxes of fruit was not the only way in which exhibitors could find out their defects or merits, for there was a fairly efficient barometer which could be studied with advantage by all, namely, the score-card compiled by the Judges. Each exhibit was given marks for the fruit, and for the way in which it was graded, packed, and presented. It was important that growers should know exactly the marks they received for their exhibits, and the Ministry therefore sent to each exhibitor a detailed account of the marks awarded for his particular exhibit—a piece of work which was favourably commented upon by growers. Every exhibitor therefore knows exactly what were his strong and his weak points at the last Show, and this information should assist in raising the standard of exhibits this year. It is not necessary or even possible in this article to deal with any special exhibit, but a comparison of the average marks obtained in the three Sections as shown in the following table may be of interest:—

STATEMENT SHOWING AVERAGE MARKS AWARDED IN THE KENT, EASTERN COUNTIES AND WEST MIDLANDS COMMERCIAL SECTIONS OF THE IMPERIAL FRUIT SHOW OF 1921, EXPRESSED AS PERCENTAGES OF THE MAXIMUM MARKS OBTAINABLE.

SCORE CARD.

Section.	Best Commercial Size.	Colour, finish, Skin, Quality.	Condition: Soundness, firmness, freedom from blemish, flavour, quality of Apples.	Uniformity of colour and size.	Quality of Pack.	General appearance of entry.	Total Points.
	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.
Kent	90	80	80	80		80	81
Eastern Counties	80	73	76	73		80	76
West Midlands	80	80	76	73		60	74

It will be observed that pride of place is taken by the Kent section. This is by no means surprising when it is remembered

that Kent is the oldest fruit-growing county and that by virtue of longer experience the Kentish growers have had greater opportunities of becoming more skilled. The venue of the Show (Crystal Palace) enabled much of the produce in the Kent section to be delivered direct in motor lorries over comparatively short distances; whereas in the other sections the boxes of fruit were sent long distances by rail. Too much importance, however, can be attributed to this, as the marks awarded for the general condition of fruit sent from the Eastern Counties and West Midlands were only slightly below those obtained by Kent. The figures appear to indicate that the Kent apples secured a considerable lead because of the care taken in selecting the best size, or, at any rate, a size which, in the opinion of the Judges, was the best commercial size. In colour, finish and skin quality the Eastern Counties fruit would seem to be behind that of the West Midland and the Kent sections, and this may be attributable to several factors. The apple of the West has long held a reputation for colour and quality, though this is counterbalanced to some extent by the effects of diseases and pests. The Kent climate is not so favourable to the production of a high colour, but the Kentish growers generally adopt hygienic methods for keeping pests and diseases, as far as practicable, under control. The climate of the Eastern Counties is by no means conducive to high colour or finish in apples, nor do the growers energetically deal with diseases and pests, and so their apples have fallen into the third place. Even in a few exhibits where fruit from the lighter soils of the Eastern Counties possessed high colour, marks were lost considerably on skin quality.

In marks obtained for "condition," under which is included firmness, soundness, freedom from blemish and flavour quality, Kent again holds a slight lead over the other two sections. This, however, may be misleading to those who examined the various classes towards the end of the Show when it was seen that the soundness and firmness of many leading exhibits had very much deteriorated. It was clearly indicated here that climatic conditions play a very important part in the soundness and general keeping qualities of apples, especially in such an abnormal season as was experienced in 1921. Their blemishes usually account for a good deal of rotting among closely packed apples, but in this case the rapid rotting of clean fruit on the third and fourth day of the Show was much in evidence. This applies particularly to the large

culinary varieties in the Eastern Counties section, but similar varieties in the West Midland section retained their condition throughout the Show.

Much can be attributed to the influence of soils on "condition" as well as on the colour of apples. The wastage of fruit grown on the moist soils of the Severn Vale was practically nil in comparison with that of the fruit from the thinner soils of the East Coast.

It will be seen, therefore, that, had the items under "condition" been separately recorded on the score-card, the loss or gain of marks awarded for each particular point of quality might be traced to both soil and climate. Such data would be of considerable value in the future development of the industry in regard to varieties and their suitability for any desired short or long distance market. The total marks awarded for uniformity of colour and size tend to indicate the ability and experience of the grower properly to grade and pack his fruit, and it is here that the Kent section probably leads in experience alone, as it was apparent to the observer that a number of exhibitors in the other two sections were making their first attempts at modern grading and packing.

It is in this direction, it would appear, that future exhibitors can reach a higher standard of excellence by studying carefully the number of marks gained by them under these two headings at the previous Show.

"Quality of pack" might be looked upon as the determining factor in deciding whether a grower is adopting an up-to-date and commercial method. It may be desirable to mention, however, that too much should not be assumed from the award of marks for this at the last Show. Various forms of packing, good and bad, were used in all three sections, for the reason that no rules defining any standardised system were laid down, and it became obvious that varied opinions would exist among the Judges on this extremely important and technical subject. The need for a standardised method of packing boxed apples was clearly borne out midway through the Show when cases of apples with premier awards were showing considerable damage and rotting through being packed attractively in the first place, but not commercially, as was ultimately proved by later observations. Nevertheless, the summarised results of the total percentage of marks for the three sections go a long way to show where the present standard of grading and packing is low and where educational work of this nature is mostly desired.

The final item on the score-card, namely, the awarding of marks for the general appearance of entry, is also an important matter. Unclean packages, torn lining paper, unnecessary packing materials, etc., do not command that attention which is readily obtained from buyers if a little care is given to the style and attractiveness of a package of fruit, whether exposed for sale or unopened. The value of an attractive appearance should not be underestimated when placing a package of quality apples before the public, whether for sale or exhibition.

At the forthcoming Imperial Show, exhibits not complying with the standard commercial regulations recently recommended by the Advisory Committee will be disqualified by the Judges, and exhibitors should pay special regard to the rules governing packages and style of "packs" to be used.

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NOTES ON FEEDING STUFFS FOR OCTOBER.

E. T. HALNAN, M.A., Dip. Agric. (Cantab.),
Ministry of Agriculture and Fisheries.

The Use of Roots for Stock Feeding.—The root crops this year promise on the whole to be very good, and on most farms roots will be in abundance for use for feeding stock. A few notes on the feeding of roots may therefore be welcome here. Under the term root crops, we include as a general rule, potatoes, carrots, swedes, turnips, kohl rabi, mangolds and sugar beet.

Composition.—Root crops are all succulent foods, containing a large amount of water, varying from approximately 75 per cent. in the potato to over 90 per cent. in the turnip. In fact, the turnip contains less solid matter than milk. Roots are "starchy" foods, that is, they contain a large amount of starchy or sugary material, and very little protein or flesh forming material. Potatoes are rich in starch (about 21 per cent.), sugar beet is rich in sugar (15-20 per cent.), and carrots, mangolds, swedes and turnips, although they contain less than 10 per cent. of starchy material have it in the form of easily digestible sugars.

Use.—Root crops are bulky foods and are therefore largely used for ruminating animals such as cattle and sheep, although they are of distinct value to pigs when fed in smaller quantity. They form a succulent feed, and owing to their cooling and laxative effect, are very suitable for use with straw and certain

DESCRIPTION.	Price per Qr. s.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv. s.	Price per lb. Starch Equiv. d.
Wheat, British	*41/6	504	9 4	1 0	8 4	71·6	2/3	1·2
Barley, British Feeding	*31/6	400	8 16	0 18	7 18	71	2/3	1·2
" Canadian No. 4 Western	—	—	—	0 18	—	71	—	—
Oats, English White	—	—	—	0 19	—	59·5	—	—
" , Black & Grey	*26/-	336	8 13	0 19	7 14	59·5	2/7	1·38
" Scotch White	—	—	—	0 19	—	59·5		—
" Chilian	28/-	320	9 16	0 19	8 17	59 5	3/0	1·61
" Canadian No. 2 Western	32/-	320	11 4	0 19	10 5	59·5	3/5	1·83
" " No. 3 "	29/3	320	10 5	0 19	9 6	59·5	3/2	1·70
" " No. 2 Feed	28/-	320	9 16	0 19	8 17	59·5	3/0	1·61
" American	25/-	320	8 15	0 19	7 16	59·5	2/7	1·38
" Argentine	27/3	320	9 11	0 19	8 12	59·5	2/11	1·56
Maize, Argentine	43/6	480	10 3	0 17	9 6	81	2/4	1·25
" American	36/-	480	8 8	0 17	7 11	81	1/10	0·98
" South African	38/6	480	9 0	0 17	8 3	81	2/0	1·07
Beans, Rangoon	8/-	112	8 0	1 15	6 5	67	1/10	0·98
Peas Japanese	41/-	112	41 0†	—	—	—	—	—
Buckwheat	52/-	392	14 17	—	—	—	—	—
Millers' offals—								
Bran, British	—	—	6 7	1 16	4 11	45	2/0	1·07
Broad Bran	—	—	8 0	1 16	6 4	45	2/9	1·47
Fine middlings (Imported)	—	—	9 2	1 7	7 15	72	2/2	1·16
Coarse middlings (British)	—	—	8 5	1 7	6 18	64	2/2	1·16
Pollards (Imported)	—	—	6 15	1 15	5 0	60	1/8	0·89
Rice Bran	—	—	7 15†	—	—	71	—	—
Barley Meal	—	—	11 5	0 18	10 7	71	2/11	1·56
Maize "	—	—	9 5†	0 17	8 8	81	2/1	1·12
" " S. African	—	—	9 0	0 17	8 3	81·3	2/0	1·07
" Germ Meal	—	—	9 2	1 5	7 17	85·3	1/10	0·98
" Gluten-feed	—	—	9 0	1 11	7 9	75·6	2/0	1·07
Locust Bean Meal	—	—	8 15	0 9	8 6	71·4	2/7	1·38
Bean Meal	—	—	13 10	1 15	11 15	67	3/6	1·87
Fish "	—	—	15 0	5 10	9 10	53	3/7	1·92
Linseed Cake, English (9°/₀ oil)	—	—	12 12	2 6	10 6	74	2/11	1·56
Cottonseed " English (5°/₀ oil)	—	—	7 15	2 6	5 9	42	2/7	1·38
" " Egyptian (5°/₀ oil)	—	—	7 10	2 6	5 4	42	2/6	1·34
Decorticated Cottonseed Meal (9°/₀ oil)	—	—	12 0	—	—	—	—	—
Coconut Cake (6°/₀ oil)	—	—	9 15	1 19	7 16	73	2/2	1·16
Palm Kernel Cake (6°/₀ oil)	—	—	7 10†	1 9	6 1	75	1/7	0·85
" " Meal (1½-2°/₀ oil)	—	—	6 2	1 9	4 13	71·3	1/4	0·71
Feeding Treacle	—	—	4 15	1 1	3 14	51	1/5	0·76
Brewers' grains, dried, ale	—	—	8 0	1 11	6 9	49	2/8	1·43
" " " porter	—	—	7 7	1 11	5 16	49	2/4	1·25
" " wet, ale	—	—	1 3	0 8	0 15	15	1/0	0·54
" " wet, porter	—	—	0 19	0 8	0 11	15	-/9	0·4
Malt culms	—	—	8 0†	2 3	5 17	43	2/10	1·52

* New. † At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of August and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 9s. per ton. The food value per ton is therefore £8 11s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 3d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·21d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

concentrated feeding stuffs that have a "binding" tendency when fed to live stock.

Quantity to Feed.—If sheep are allowed an *ad lib.* diet of roots and hay, it will be found that the maximum quantity of roots they will eat is approximately 16 lb. a day. Cattle will take up to 1 cwt. of roots per day, but it is not wise to exceed ¾ cwt. a day, except perhaps in cases where concentrated cake is fed lavishly, as with animals brought up under show conditions.

Preparation for Feeding.—It is usual, especially in feeding cattle, to pulp or slice roots when feeding with hay or straw. The usual practice is to chaff the hay or straw, mix with the sliced roots, and allow to stand for 12 to 24 hours before feeding. This seems to soften the chaff and makes a mixture relished by stock. Roots may be fed whole, as is the general practice with sheep, but in the case of horses it is always advisable to slice before feeding, especially if the roots have a tendency to be woody.

Time to Feed.—The usual practice in feeding roots is to feed off turnips first, follow with swedes and finish on mangolds. It is always a sound practice, if possible, to avoid feeding mangolds before Christmas, as new mangolds tend to cause scour.

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A Lincolnshire Small Holding.

IN the course of the inspection of statutory small holdings in Lindsey (Lincs.), the Ministry's District Commissioner noticed a holding which appears to merit a description in some detail. The holding is situated at Bradley, three miles from Grimsby. It comprises 39 acres of arable land, the soil being a strong loam, and the rent is £2 2s. 0d. per acre.

Three brothers, all unmarried ex-Service men, live on the holding. The holding was let to the eldest of the brothers at Lady Day, 1919, as bare land at an economic rent. Before joining up, the tenant was a carter in Grimsby, and his entire capital was derived from his savings as a carter.

The tenant has himself provided on the holding a small timber-built bungalow, a stable, a cowhouse, a place for calves, a large piggery and an outhouse, concrete being used throughout for flooring. Also an implement hovel roofed with straw, poultry houses, and a road-way to the bottom field faced with ashes two feet thick and a post-and-wire fence to fence off a paddock have been made. Altogether, he has expended about £600 on the equipment of the holding exclusive of the labour of carting.

The holding was taken in a bad condition and foul land had to be cleaned. After three years of tenancy, the land is in a high state of cultivation and very clean. Hundreds of loads of fish refuse have been carted from Grimsby Docks, four miles distant, all the arable land having been manured in this way. In addition, farmyard manure has been used and basic slag is being put on the permanent pasture. Seed potatoes direct from Scotland are planted.

The tenant's elder brother works the horses: the younger brother, much disabled as a result of War service, keeps house and looks after the poultry. The tenant himself supervises, delivers market-garden produce to retail shops in Grimsby, and sells and delivers bundles of green clover to carters in Grimsby. He fills in his spare time on the holding from early morning till late at night.

In view of the possibility of a slump in the sale of vegetable produce, the holding has been variously cropped this season as follows:—

4	acres	wheat.
6	,,	oats (winter and spring).
3	,,	barley.
7	,,	potatoes (early, medium and late).
9	,,	clover.
1	,,	vetches.
2	,,	swede turnips.
1	,,	mangolds.
2	,,	cabbages.
½	,,	carrots.
3	,,	permanent pasture.
½	,,	homestead.

The live stock on the holding consists of:—3 working horses, 1 mule, 2 cows, 6 calves, 40 pigs, 60 head of poultry.

The water supply to the holding is provided free of cost by the resident tenant of an adjoining property who laid down a pipe across the boundary at his own expense in consideration of the fact, as he said, that his neighbour had served his country during the War.

Owing to the high state of cultivation of the holding the effect of the drought last year on spring oats, clover and potatoes was not nearly so noticeable as on some other land.

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THE Ministry of Agriculture and Fisheries desires to give notice that the "Seeds Regulations, 1921," which were made in pursuance of the provisions of the Seeds Act, 1920, were withdrawn as from the 10th August, 1922, and have been replaced by the "Seeds Regulations, 1922." The terms of the new Regulations are practically identical with those of the previous Regulations, except as regards the following points:—

Seeds Regulations, 1922.

1. Grass and Clover Seed when sold, or exposed for sale, for other than agricultural purposes (*e.g.*, as lawn grass seed), will be excluded from the operations of the Seeds Act.
2. A statement as to the percentage of pure germinating seed or "real value" of grasses and clovers is no longer required.
3. Alsike and White Clover, when grown together, may be treated, for the purpose of the Regulations, as one seed, provided they are declared to have been grown together.
4. Sprouted Cereal Seeds are not to be treated as impurities for the purpose of testing, that is to say, they are not to be picked out of the sample put up for the germination test.
5. The authorised minimum percentage of germination in the case of Broccoli and Cauliflower Seed is reduced from 65 per cent. to 60 per cent.
6. Seed Potatoes, the variety of which is less than the Standard Purity of 97 per cent. may now be sold as seed potatoes, provided such potatoes are declared as being of mixed varieties.

Copies of the Seeds Act, 1920, and of the Seeds Regulations, 1922, may be obtained through any bookseller, or directly from H.M. Stationery Office, Imperial House, Kingsway, net price 3d. each.

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As from 1st August, 1922, the following increases were made in the fees charged by the Official Seed-Testing Station for testing samples of seeds:—

Increased Seed-Testing Fees.

	Old Fee.	New Fee.
Grasses and Clovers -	4s.	5s. per sample.
Mixtures of Grasses and Clovers - - -	4s.	10s. ,,

Mixtures of Perennial and Italian Ryegrass, and mixtures of Alsike and White Clover, when stated to have been grown together, will not be regarded as mixtures and will be tested for 5s. per sample.

Special facilities are now offered for carrying out tests on payment of the ordinary fee plus an additional charge of 50 per cent. thereof, and the cost of telegraphing the result of the test if a telegram is asked for. These facilities are only granted to samples which are plainly marked with the word RAPID. No other form of words will be recognised.

All other fees, including the farmer's fee of 6d. per sample, remain unchanged.

A leaflet, giving full particulars of the fees and conditions of testing, can be obtained, post free, on application to the Chief Officer, Official Seed-Testing Station, Huntingdon Road, Cambridge.

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Landing of Animals from Ireland.

AN Order entitled The Irish Animals Order of 1922 has been issued by the Ministry modifying the restrictions imposed in respect of the landing of cattle, sheep, goats and swine from Ireland, so as to permit of the landing both of fat and store animals of each species.

Cattle and sheep may not be removed from the landing places except with a licence granted by an Inspector of the Ministry, and then only to—

(*a*) Markets specially authorised by the Ministry, from which they will be moved by licence to private premises for detention thereon for 13 days, *or*

(*b*) Private premises for detention thereon for a like period unless slaughtered in the meantime.

The following special markets have been approved in Scotland, viz., Aberdeen, Edinburgh, Forfar, Laurencekirk, Perth and St. Boswell's, and the Ministry is now inquiring into the demand for a similar number of special markets in England.

Swine may be removed from the landing places with the requisite licence granted under the Swine Fever (Movement from Ireland) Orders of 1904 or 1906, as the case may be.

An Important Prosecution.—For contravening the Animals (Landing from Ireland) Order of 1922, several cattle dealers have been recently prosecuted and in some cases very heavy fines inflicted.

An outstanding conviction was that obtained against an Irish dealer for several offences against the Order. These included the moving of cattle to a place other than that named in the licence granted him and failing to surrender the licence in the

manner prescribed in the Order. In inflicting a fine of £101 5s. the offender was severely censured by the magistrates who said that the offence might have cost the country an enormous sum of money.

In view of the urgent necessity for preventing the spreading within this country of Foot-and-Mouth Disease, it is essential that the strictest attention should be paid, by cattle dealers and farmers, to the compliance with the requirements of Orders relating to the movement of cattle. It should be unnecessary to point out that such Orders are designed solely to protect the interests of the cattle industry.

Persons obtaining licences for movement of animals should make themselves thoroughly acquainted with the conditions under which they are issued and the obligations attaching thereto.

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Agricultural Credit in Ontario.

DURING the first four months of operation of the Agricultural Development Board* of Ontario, the Province has lent to farmers in long term loans $571,570 and in short term loans $25,000. The extent of the demand for Government loans is indicated by the fact that 3,000 applications have been received. It is stated that the scheme is achieving one of its chief objects in keeping many farmers' sons on the land. The father secures a loan from the Government to buy an adjacent farm for his sons, mortgaging both farms in order to get the loan. The system also enables city men, who have had perhaps some farm experience in youth, to take up farming. Farmers who have lost their buildings through fire are also aided. 75 per cent. of the applications are for loans for building purposes. In some cases loans are obtained to pay off existing encumbrances, as loan companies demand 7½ per cent. to renew, whereas the Agricultural Board lends the money to the farmers at 6 per cent.

There is a strict system of local inspection in order to prevent undesirable persons from getting loans. The Board charges $12 as inspection fee in granting a loan, and legal fees of $10 on loans up to $2,000 and $20 on loans up to $12,000. The farmer can safely do without a lawyer when dealing with the Board. Long term loans have been granted to farmers in 32 counties.

At least a third of the applications have come from northern Ontario, which is the part of the province not yet fully developed.

* Cf. *Industrial and Labour Information*, Vol. I, No. 7, p. 411.

In that district the loan companies charge 10 per cent. interest and limit their advances to 40 per cent. of the value of the property.

Short term loans can be secured only through farm loan associations composed of 30 farmers, each of whom has subscribed for a $100 share and paid in $10. The municipality and the province in which the farmers live have to make a similar contribution. Farmers from every county in the province have asked for information concerning such associations, but the Board takes no action until five or more farmers have so petitioned. The first association was formed last December. At present 25 are operating, and many others are nearly completed.

These short loans are intended chiefly for the purchase of cattle and seed. Money is lent to the association by the Government at 5½ per cent. and advanced to the farmer by the association at 6½ per cent. The maximum loan is $2,000. As the bank short loans are limited to three months and farmers need money for a period of nine months, the new provincial scheme meets a real need.

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The Cultivation of Osiers and Willows.

IN 1913 the Ministry published Miscellaneous Publication No. 18 on willow-growing, based largely on information supplied by Mr. W. Paulgrave Ellmore, of Leicester. A new edition of this publication has now been issued and can be obtained by ordering direct from the Ministry, 10, Whitehall Place, London, S.W.1, price 1s. 6d. net post free. It has been largely re-written, a chapter on the growing of tree willows has been added, and the notes on the cultivation of basket willows expanded, greater stress being laid on the special methods employed in the various willow-growing districts, each of which had evolved certain characteristic features. The booklet has been revised by the members of the Advisory Committee on Willow Growing set up by the Ministry, and is fully illustrated.

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Foot-and-Mouth Disease.—An outbreak of Foot-and-Mouth Disease occurred in Water Street Pig Market, Manchester, on the 24th August, after Great Britain had been free from outbreaks since the 30th June last.

The usual restrictions were imposed and every step taken to trace the origin of the disease. Up to the present, however, this has not been discovered.

There have been no further outbreaks either in the Manchester district or in any other part of the country.

Rabies, Southampton.—A case of Rabies in a dog at Itchen, in the Borough of Southampton, was reported on the 5th May, and the nature of the disease was confirmed by the Ministry. A muzzling and prohibition of movement Order, covering a radius of 15 miles from Southampton, was made. No further case having occurred in the district, all restrictions were withdrawn as from the 10th September.

Leaflets issued by the Ministry.—Since the date of the list given on page 286 of the June issue of the *Journal*, the following new leaflets have been issued:—

No. 386.—Ragwort.
„ 387.—Spurrey.
„ 390.—Description of Certain Diseases of Animals.
„ 392.—Cultivation of Catch Crops and Home Grown Feeding Stuffs.
„ 393.—Tomato Culture.
„ 394.—Phosphatic Fertilisers.

The following have been revised or rewritten :—

No. 33.—Surface Caterpillars or Cutworms.
„ 72.—Purchase of Artificial Manures.
„ 122.—Cabbage Root Fly.
„ 156.—Hedgerow Timber.
„ 189.—Insurance of Farming Stock against Fire.
„ 258.—Rural Party Line Telephones.
„ 34.—The Woolly Aphid.
„ 63.—Destruction of Charlock.
„ 98.—Grading and Packing of Apples.
„ 167.—Duck Keeping for Egg Production and Table.

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NOTICES OF BOOKS.

Veterinary Hygiene.—(R. G. Linton, M.R.C.V.S., Professor of Hygiene, Royal (Dick) Veterinary College, Edinburgh. Royal 8vo ; 415pp., 92 illustrations. Edinburgh 1922, W. Green & Son Ltd., price 26s. net.) This volume is one of the Edinburgh Veterinary Series of which the general editor is O. Charnock Bradley, M.D., D.Sc., M.R.C.V.S., Principal, Royal (Dick) Veterinary College, Edinburgh. It is intended for the use of students, veterinary practitioners and others concerned with the wellbeing of animals. Sections on water, meteorology, sanitation, air and ventilation, building construction, preventive medicine and sanitary law are dealt with in a lucid manner without raising too many controversial topics. The author has received considerable help from many experts and quotations are numerous. A bibliography at the end of each section would, however, have enhanced the value of the volume considerably and helped those desirous of more detailed study.

The section on building construction is praiseworthy and practical, and fills a long felt want in books dealing with veterinary hygiene. Particulars of the construction and ventilation of live stock carrying vessels are not given, but useful and essentially practical information is furnished concerning buildings for animals with the exception of kennels and goat houses. Findlay's method

of ventilating cowsheds, which is largely used in the S.W. of Scotland, is described by the author as the ideal one. The use of fireclay ridge ventilators is condemned. A system of lighting cowsheds whereby the hindquarters of the cows are clearly visible is recommended, and those interested in the production of clean milk will profit by the study of the notes given. The text dealing with the reconstruction of insanitary buildings could be improved on by illustrations showing what can be done with existing walls. Whole-time municipal veterinary officers are frequently called upon to draw up a specification of work required in reconstructing insanitary cowsheds, but one looks in vain to the work under review for assistance. Methods of reporting on buildings and animals are also omitted.

Preventive medicine is discussed in a masterly manner, and many up-to-date hard facts are quoted in connection with the scheduled diseases. The author is in error in stating that "in the case of Swine Fever the disinfection is under the control of the lay inspectors of the Ministry of Agriculture, the Veterinary Inspector has nothing to do with it." Further notes on the disposal of carcasses are desirable and in these days of economy it is somewhat surprising to see so much space devoted to Bostock's expensive method of cremation.

Tuberculosis in animals is dealt with in detail and the statement is made that milk from a tuberculous udder always contains Tubercle baccilli. Some of the parasites found in animals are described and much useful information is given concerning their control and eradication.

The section on Sanitary Law is dealt with in a concise manner and herein lies its weakness. Many important Acts and Orders do not receive notice and important legal decisions are not supplied. While discussing law it is always advisable to quote the relevant section or article.

Although a few points in which improvement could be made have been mentioned, the book can be thoroughly recommended as a safe guide and the author deserves congratulations for having condensed the subjects under discussion admirably. The publishers have performed their duty in their usual thorough manner.

Insect Pests of the Horticulturist: Their Nature and Control. Vol. I.—Onion, Carrot and Celery Flies.—)By K.M. Smith and J. C. M. Gardner: Benn Bros. Ltd., London; price 7s. 6d. net.) Vol. I of this work deals with the bionomics and some control trials undertaken against the Onion, Carrot and Celery Flies. Structural and other figures are given in black and white, the book should prove useful to students and others interested in Economic Entomology.

Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE,
By Metchim & Son, Princes Street, Westminster, S.W. 1.

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXIX. No. 8.

NOVEMBER, 1922.

NOTES FOR THE MONTH.

Sir Arthur Boscawen's Farewell Address to Farmers.

SPEAKING at the National Farmers' Union Dinner on Wednesday, 18th October, Sir Arthur Boscawen said that, as they well knew, there was a very serious crisis in political affairs, the result of which nobody could foresee, but there might be changes in the Government or a complete change of Government in the near future. This might, therefore, be the last occasion on which he should address a meeting of the National Farmers' Union as Minister of Agriculture. In saying that, he would like to add that his relations with the National Farmers' Union had always been most cordial and they had reposed in him confidence in a most generous way. He should never forget their kindness and could assure them that in whatever capacity he might be in the future, he would always do his best to further the cause of agriculture, and especially of those who were actually engaged in the cultivation of the soil. The fact, however, that this might be the last occasion enabled him to speak more freely than otherwise he might have done.

Agriculture was certainly going through a critical time, and he had the deepest sympathy with all classes engaged in it, owners, farmers and labourers. Undoubtedly, at the present moment, in many departments the industry could not be made to pay, but he thought there was a good future for the dairy farmer and fair hopes for the live stock industry generally; he did not see, however, how arable farmers, especially corn growers, could carry on on anything like the present scale. The result of this would be, as Mr. Orwin had pointed out in *The Times*, that the country would revert to grass very rapidly, that there would be a great decrease in the rural population and much temporary unemployment and distress. It looked as if the future of British agriculture lay in large farms cultivated cheaply and with low production, interspersed with patches of land intensively cultivated for fruit and vegetables in certain

(45571). P.1./R.8. 10,500. 10/22. M. & S.

favoured localities. What could be done to stop this? There were two remedies which would be effective, but neither of them he thought was politically practicable. One was a tariff and the other subsidies. He did not believe the country, which was predominantly urban, would stand either. They must recollect that the agricultural population was a small fraction of the total population of the country, and the great majority of the electors, of the House of Commons, and by consequence of the Government of the day, whatever party the Government belonged to, would be predominantly urban.

The fact was that the industry must work out its own salvation on an economic basis, and all that the Government could do or would do, was to assist by measures which he would only describe as palliatives. Personally, he advocated the following: First, a relief in the burden of rating where the farmer was unfairly assessed compared with other people, since he had to occupy such a very large amount of rateable property in order to earn his living. But they must not expect salvation from rating reform. He had seen the accounts of several farms where accounts had been most scientifically kept, and the rates only counted for about 3 per cent. of the total outgoings. In the next place, rating reform was very difficult because the urban ratepayers demanded relief also. In many of our great towns the rates were over 20s. in the pound, and it would be very difficult to deal with agricultural rates apart from the rating question generally, but they should press for a general revision of the rating system coupled with some special relief to agricultural land.

In the next place, he thought it would be possible that the Government should set up better credit facilities than existed for farmers to-day. A small committee had been appointed to investigate the possibility of establishing with Government assistance co-operative land banks for the purpose of making loans to land-owners for permanent improvements and also short-term loans to farmers to enable them to carry on their business. This was very necessary since the alteration in the system of banking in this country and the elimination of the country banker had made it difficult for farmers to obtain loans on reasonable terms without collateral security.

Then he thought that inquiry should be instituted into the question of railway rates in order to ascertain definitely whether preference was or was not given to produce coming from overseas, and with a view to reducing the present rates.

But beyond all things, the question of distribution must be overhauled. He made no general charge against the middlemen that they were making excessive profits. When we saw that English wheat was selling to-day at little more than pre-war prices, while bread was costing little less than twice pre-war prices, there must be something radically wrong with our system of distribution. There were too many persons and too many interests interposed between the producer and the consumer. Here he thought the farmers had the remedy chiefly in their own hands, and the Government could do little. Co-operation appeared to be the solution. It was this difficulty between wholesale and retail prices that caused the chief trouble to-day. The farmer, unable to see how to make a profit, attempts to do so by cheapening the cost of production, and the only item where he can secure a reduction worth mentioning is labour, which accounts for nearly 50 per cent. of his costs. But the labourer, owing to high retail prices, can scarcely live on a wage less than he is getting now. There is the difficulty. The farmer says: "I cannot pay more than 25s. a week," and the labourer says: "I cannot live on less than 30s."—both appeal to the Government. The Government is powerless to act, except by giving a subsidy which would in effect be a subsidy to wages. We should be getting back to the system of the old Poor Laws, when wages were directly subsidized by the ratepayer, a system which was condemned by all parties and was thoroughly unsound. He had seriously thought of trying to reintroduce a subsidy on arable land as a temporary expedient for one year, provided that the farmers continued to employ as many men as now and to pay not less than the present wages. His idea was to tide over an acute crisis, but he did not think that the plan was possible. Other industries, for example, the mining industry, which was suffering seriously to-day, would claim the same assistance, and we should not be sure that the experiment once made would not have to be repeated next year.

All this he knew was but cold comfort, but they must fight on and make the best of the situation. He did not believe the depression would last. He believed the present distress was due to temporary causes, the first being the thoroughly uneconomic methods we employed during the War, and the second, the collapse of foreign exchanges, which made this country the dumping ground for the superfluous products of the whole world. These causes would gradually disappear, and he thought a period of high prices was not very far distant. In the meantime,

however, he feared that some farmers would go under and that there would be much unemployment and distress among the labourers, but he could honestly say that he had not failed to bring the position in all its gravity before his colleagues.

As a member of the Government he would add one word. It was not true that the present Government had neglected agriculture. Only this year we had altered the assessment for income tax in the interest of the farmer, which he knew brought substantial relief in many cases, and we had remitted the duty on home-grown sugar in order to stimulate a new and valuable industry. Then, we were spending very large sums on agricultural education and research, which had in the past, and would still more in the future, help to reduce the cost of production. These were sound lines to proceed upon, and he did not know what more could be done at the present, except in the direction of those reforms to which he had alluded.

One word in conclusion. He had pointed out that agriculturists in this country were in a minority; then by all means let them stand together. The interests of owner, farmer and labourer were identical, yet too often we found them pulling against each other. There was, however, certainly a tendency to come together now, which was largely due to the action of the National Farmers' Union. Unless they all stood together, they would not have much chance of making their voices heard, and he would advise: keep agricultural policy and party politics quite apart. The National Farmers' Union did this, and he could fairly say that while he had been Minister, he had never approached agricultural questions from a party point of view. With regard to the labourers, it was a matter for regret that their Unions were tied to one political party. He did not say this out of any disrespect for the leaders of the Unions, for many of whom he had great respect, but it could not be good that the interests of agricultural labour should be identified with a political party.

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Importation of Canadian Store Cattle.

IN consequence of the resolutions adopted by the House of Commons on 24th July and by the House of Lords on 26th July, a Conference was held at the Colonial Office on 14th October between representatives of H.M. Government and of the Canadian Government to discuss the admission of Canadian cattle. Mr. Churchill presided, and in addition there were present Sir Arthur G. Boscawen, Minister of Agri-

culture and Fisheries; the Hon. W. S. Fielding, Minister of Finance, Canada; the Hon. E. Lapointe, Minister of Marine, Canada; the Hon. P. C. Larkin, High Commissioner for Canada in London; and representatives of the Ministry of Agriculture and Fisheries, the Scottish Office, the Board of Agriculture for Scotland, and the Canadian Department of Agriculture.

A general discussion on principles having taken place, certain technical questions were remitted to a committee of experts representing both countries.

Further meetings of the Conference were held on the 18th and 20th October, Sir Arthur G. Boscawen presiding, in the absence of Mr. Churchill through illness. The conclusions of the committee of experts were considered and the Conference agreed upon the main conditions which should govern the importation of Canadian cattle into Great Britain, and these terms will be submitted to the new Government with a view to the introduction of the necessary Bill when Parliament next meets.

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Clean Milk Production.

THE demand for clean milk is increasing. Great efforts are being made to educate the public to appreciate clean milk and to call for its supply.

Quite apart from the fact that the production of milk in a cleanly manner brings its own reward by causing the milk to keep sweet longer and hence avoiding loss by souring, the indications are that, in future, clean fresh milk will command the most satisfactory market.

The section of the Milk and Dairies (Amendment) Act, 1922, which refers to grading, is due to come into operation on 1st January next. From that time more attention to the production of milk of a definite grade is a matter deserving of the attention of every dairy farmer.

The regulations applying to the different grades will be embodied in an Order to be issued by the Ministry of Health. When the Act was passed, it was contemplated that, apart from ordinary milk, there would be two main grades, namely, "Certified," and "Grade A," but a provision was embodied empowering the Minister of Health to establish additional grades. The grade "Certified" will be what has hitherto been known as "Grade A (Certified)." It is milk of the highest purity, produced only from cows which have passed the tuberculin test. It must be bottled on the farm, and at any time before it reaches the consumer it must not contain more than 30,000 bacteria per

cubic centimetre. In addition it is necessary to comply with certain specified conditions as judged by inspection. It follows therefore that the production of "Certified" milk is a specialised business, and that such milk must be sold at an enhanced price to meet additional costs in production and distribution. It is not expected that this grade will monopolise the market, but the demand for it is steadily growing, and for those who are prepared to lay out capital in establishing a herd which passes the tuberculin test, in providing the necessary equipment, and who will take the trouble to train their employees, it does offer economic possibilities.

"Grade A" will, as at present suggested, be divided into two sections, namely, "Grade A, Raw," and "Grade A, Pasteurised." The herds producing milk of this grade (both sections) are not to be required to pass the tuberculin test, but they will be required to pass a physical inspection made by an approved veterinary surgeon. In the case of "Grade A, Raw" milk the only other requirement which need be mentioned is that it must not at any time before it reaches the consumer contain more than the number of bacteria which will be specified in the Order. To qualify for a licence to sell "Grade A, Pasteurised" milk the act of pasteurising must be performed in accordance with a prescribed method, and the milk so treated must afterwards comply, in respect of the number of bacteria contained, with a much lower count than in the case of "Grade A, Raw" milk. Generally speaking it is not expected that the ordinary farmer will be able to produce and sell, directly, "Grade A, Pasteurised" milk. His part will be to supply "Grade A, Raw," milk either for direct consumption or to a wholesale dealer or co-operative society who will carry out the work of pasteurisation.

It is likely that in course of time there will be a considerable demand for Grade A milk. No farmer need be afraid of the conditions with which it will be necessary to comply in order to obtain a Grade A certificate. There will be nothing in them that any producer cannot meet provided he and his employees will take the trouble to study and adopt the most approved methods of guarding against contamination, and that he will cool his milk well. What is wanted is an intelligent appreciation, by employer and employed, of the things that matter, and a determination to carry them out.

The Ministry has had experience of the useful work which can be done by County Instructors in helping farmers and farm

workers to master the art of clean milk production. It has been found that such assistance is effectively rendered by holding practical demonstrations on the farm followed by such lectures as may be necessary to explain the why and wherefore of the precautionary measures adopted, and by the organising of clean milk competitions. Because of this experience, and because it is expected that the farmers' need for such assistance will be greater in the future than it has been in the past the Ministry has recently addressed a letter on the subject to all County Education Authorities in England and Wales (see p. 764).

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Fluctuations in Live Weight.

THE articles by Mr. E. S. Beaven which recently appeared in the *Journal* on the subject of variety trials of cereals, point very emphatically to the need for greater care and accuracy in carrying out agricultural experiments of one description. That equal care is needed in relation to another description of experiments—feeding trials with cattle—may also be emphasised.

For example, in the *Agricultural Journal of India* for May of the present year. there appears an article entitled "Normal Fluctuations in Body Weight of Bovines." It deals with a subject which is of great importance to all experimenters undertaking feeding experiments with cattle. In carrying out such trials it is sometimes the practice to record only initial and final weights of animals under experiment. In determining these weights it is generally considered sufficient to ascertain the fasted live weight on one or two succeeding days at the beginning and close of the experiment. In the case of the experiments under notice, however, daily weighings were made of a number of animals (buffaloes) for a period of 88 days. Charts are published showing the daily variation of two animals, one set of a "control" and the other of an animal receiving a fattening ration. These charts show the most surprising changes from day to day. For example, we have such figures as the following on successive days :—324, 329, 342, 336, 332, 329, 335 and (eleven days after) 305, 310, 320, 315 lb. Similar results were obtained from a large number of animals. The principal conclusions arrived at are (1) that any conclusions as to the suitability of a ration or feeding stuff when based on data obtained from initial and final weighings, or weekly or fortnightly weighings, are practically valueless, (2) that weights should be taken daily, and conclusions based on the averages of weighings of groups of at least ten successive days.

It is improbable that the fluctuations observed were due to conditions peculiar to India. The author quotes an American experiment (Armsby, *The Nutrition of Farm Animals*, 1917) which points to the same conclusions, and in which daily fluctuations in the weight of a mature steer up to 5 per cent. of the body weight were observed. Many American investigators now take averages over ten successive days, in carrying out experiments involving the live weights of cattle.

Then, in this country, variations of the same order were recently observed in the course of certain experiments on the nutrition of cows carried out at Leeds University by Crowther and Woodman. Fluctuations in the weights of cows up to 43 lb. on two successive days were observed.

Facts of this description show how necessary it is under modern conditions to secure greater accuracy than has been observed in the past in experimental work with animals. The sources of error in feeding trials may be even greater than those with which Mr. Beaven's trenchant articles were concerned, for not only is the weight of one animal subject to considerable fluctuations but the variation from animal to animal is very large.

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Village History.

OF the value of local history no one now needs to be convinced. Its inspiration serves not only to preserve what is best in the past, but to assure a higher standard of living in the present. More of us than ever now know those little towns of Flanders where the unlovely creations of the eighteenth and nineteenth centuries are replaced, sometimes, perhaps, with a too conscious archaism, by worthier memorials of the genius of the country, and where it is hard to escape Flemish pottery, Flemish lace, Flemish silverwork, Flemish beer. Even if the emphasis is a little overdone, if there is too much stage furniture designed to please the eye of the visitor, yet commercialism at its worst cannot undo the good that lies in building houses which really do express something of the spirit of the people, and in making wares which are known for what they are without the aid of an inscription.

Mr. Guy Ewing, whose account of an interesting experiment appeared in the October issue of this *Journal*, makes an effective plea for the practical study of village history. He has worked single-handed, but lest others who are not equipped as he is for the task should hesitate to follow his example, it is not out of place to remind them that assistance may be had

from several quarters. The Historical Association (22, Russell Square, W.C.) is now a large body with branches all over the country: one of its aims is to foster the study of local history, and the co-operation of a neighbouring branch is almost certain to be forthcoming. Archæological societies exist in many counties, and the officers and members are always willing to give advice and help in exploring the history of a village and in the discovery of its antiquities. Much can be done, even without such help, by anyone who will study such books as Dr. Charles Cox's "How to write the History of a Parish," the Victoria County Histories and the few other county histories that rank with them, the publications of local archæological societies, and Dr. Hubert Hall's "Directory of British Archives" and his "List of Agrarian Surveys." With the aid of these books one may learn to know at least what documents to look for and where to look for them. Guidance in the search of antiquities which are not documentary is not so readily available, but Mr. and Mrs. Quinnell's "History of Everyday Things" should at least prove suggestive. A flair for recognising those things which will best illustrate the past is as desirable as knowledge: and, unfortunately, there is no recipe for acquiring a flair. But it is to be supposed that no one would undertake the task of studying or demonstrating village history on practical lines who did not possess a rudimentary flair, which practice and enthusiasm would develop.

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Lectures on Agricultural Research.

THE MINISTRY endeavours in many ways to bring before farmers the results of agricultural research—by its advisory scheme, in which college and county staffs play their part; by leaflets and articles in this *Journal;* and by miscellaneous publications such as the recently-issued volume on "Agricultural Research and the Farmer." It is now proposed to bring research workers more directly into touch with the farmer, and arrangements have been made with the National Farmers' Union to organise meetings which will be addressed by specialists in the various branches of agricultural science. The scheme is certainly an experiment, but if it proves to be as successful as is anticipated this winter, it may well obtain a permanent place in the organisation of the work of the Ministry. A list of meetings, with the dates which have so far been definitely fixed, is given below. Any inquiries with regard

to the arrangements should be addressed to the Secretary of the Branch of the National Farmers' Union concerned.

Branch of the National Farmers' Union	*Subject Chosen*	*Lecturer*	*Institute*	*Date of Lecture*
Beds and Hunts	The General Cropping of Arable Land	Mr A. Amos	School of Agriculture, Cambridge	December 16th
Bucks	Milk Production and Dairying	Mr. J. Mackintosh	National Institute for Research in Dairying	November 15th
Cheshire ...	Soil Research	Sir John Russell	Rothamsted Experimental Station	
Gloucester ...	Agricultural Rating	Mr. C S. Orwin	Institute for Research in Agricultural Economics	November 11th
Lincs	Wheat	Prof. R H. Biffen	Plant Breeding Research Institute, Cambridge University	
Lincs (Holland	Pests affecting mustard, turnip seed and peas	Prof. F. V. Theobald	Research and Advisory Dept., South Eastern Agricultural College, Wye, Kent	
Northants ...	Insect Pests	Dr. A D. Imms	Rothamsted Experimental Station	January 27th
Oxford	Insect Pests	Prof. F. V. Theobald	Research and Advisory Dept., South Eastern Agricultural College, Wye	January 10th
Pembroke ...	Silage	Mr. J. F. Blackshaw	Ministry of Agriculture	
Salop	Parasitic attacks on Cereals and Diseases of Tubers	Dr. W. B. Brierley	Rothamsted Experimental Station	November 14th
Sussex, E. ...	Digestibility of Feeding Stuffs	Prof. T. B. Wood	Animal Nutrition Research Institute, Cambridge University	—
N.R Yorks ...	Plant Breeding	Prof. R. H. Biffen	Plant Breeding Research Institute, Cambridge University	—
W.R. Yorks. Doncaster	Wireworm	Dr. A. D. Imms	Rothamsted Experimental Station	—
W.R Yorks. Leeds	Economy in Production of Winter Milk by Growing Fodder Crops	Mr. J. Mackintosh	National Institute for Research in Dairying	November 3rd

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Conciliation Committees in Agriculture.

DURING the past month the Cumberland and Westmorland Committee, whose current agreement is due to expire at Martinmas, has reached a further agreement for the following six monthly hiring period, the terms being as follows:—

I.—Skilled Workers.

Workers aged.		
21 and over	37/- per week of customary hours	Customary hours are 63 per week.
20 & under 21 ...	32/- „ „ „ „ „	
18 to 20	28/- „ „ „ „ „	
16 „ 18	23/- „ „ „ „ „	

II.—Other Male Workers.

21 & over	30/- per week of 54 hours in summer and 48 hours in winter.

III.—Female Workers.

18 & over	5d. per hour.

The precise period of operation of this agreement is from 11th November, 1922, to 19th May, 1923.

The Cornwall Committee has reached an agreement operating over the period from 23rd October to 31st December. The terms provide for the payment of efficient adult male agricultural labourers at the rate of 30s. for a week of 52 hours, and it is understood that the Committee have under consideration the question of the registration of the agreement.

The Committee for Ashby Bosworth, Hinckley and Atherstone areas has reached an agreement for the payment of 31s. 6d. for a week of 54 hours. The question of overtime rates has been deferred to a later date. In addition, the Cheshire, Staffordshire and Worcestershire Committees agreed to extend their last agreements up to 14th, 31st and 28th October respectively.

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The Agricultural Index Number.

A FURTHER fall is recorded in the index number of prices of agricultural produce in England and Wales during September, the average increase compared with the corresponding month in the years 1911 to 1913 being 57 per cent. in September against 67 per cent. in August.

In the following table are shown the increases in each month since the beginning of 1921, the corresponding month in 1911 to 1913 being taken as the basis of comparison in each case:—

Month.	*Percentage Increase in Prices.* 1921	1922	*Month.*	*Percentage Increase in Prices.* 1921	1922
January ...	183	75	July ...	112	72
February	167	79	August ..	131	67
March ...	150	77	September	116	57
April ...	149	70	October ...	86	
May ...	119	71	November	79	
June ...	112	68	December	76	

Nearly all descriptions of produce shared in the reduction, the only increase being in the case of eggs. Wheat, barley and oats all fell heavily, and the average prices during September were only from 23 to 31 per cent. higher than in the corresponding month of 1911 to 1913.

Potatoes were also cheaper and during September were at practically pre-war level, while a slight reduction occurred in the case of hay.

All descriptions of live stock experienced a fall, pigs being least affected. Milk was unchanged in price, but cheese and butter were relatively cheaper than in August, as compared with the corresponding months in 1911 to 1913. Prices of poultry remained practically unchanged, but eggs advanced sharply, decidedly more so than was customary between August and September before the War.

The reduction in the general index number of all produce was materially assisted by a further reduction in the prices of fruit and vegetables, the former averaging about 16 per cent. below and vegetables 20 per cent. above the prices ruling in September before the War.

The following table shows the average increase during recent months in the value of the principal commodities sold by the farmer:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13

	April.	May.	June.	July.	Aug.	Sept.
Wheat ..	57	62	60	53	53	23
Barley ...	49	49	58	49	48	26
Oats ...	49	53	57	55	59	31
Fat cattle ...	65	70	71	70	70	58
Fat sheep ...	128	140	121	107	103	90
Fat pigs .	90	91	82	91	92	84
Eggs ..	89	50	69	80	64	96
Poultry ...	83	110	116	103	85	85
Milk	42	27	28	53	70	70
Butter ...	49	54	59	79	77	76
Cheese ...	46	48	55	50	51	41
Potatoes ...	95	140	80	75	14	1
Hay	28	33	35	37	54	52

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THE POSSIBILITY OF USING TOWN REFUSE AS MANURE.

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IN recent years the shortage of town stable manure has compelled farmers who used to rely on this material to cast about for substitutes. Among the various possibilities is to be reckoned ashpit refuse, which is available in large quantities but is at present used to a very limited extent. Most of us have seen and smelt the huge refuse dumps that have grown up round London, and if the fertiliser value could be assessed by the disagreeable odour the case for town refuse would be sufficiently convincing. As might be expected, there is an increasing reluctance on the part of country people to allow the countryside to be disfigured in this way. A less objectional method than that of dumping in country districts is to incinerate the refuse, but this is costly, and of course is sheer waste. More up-to-date town authorities are now making an effort to dispose of their refuse in a better and more useful way, and some are adding other wastes and crushing the whole for use as a fertiliser.

Present Use as Manure.—It is not easy to arrive at any clear estimate of the fertiliser value of so mixed a material as town refuse. Analysis alone does not afford sufficient information, and field trials, which constitute the only reliable means, are very slow.

There is, however, a certain body of experience on the part of farmers who have used town refuse on which one may usefully draw for guidance. Broadly speaking, town refuse has given successful results in two cases :—

(*a*) On heavy-land farms or allotments, where it is used for root crops, cabbages, etc.;

(*b*) For raising the level of low-lying wet ground and forming new land which can be used for allotments.

Considerable quantities of town refuse have been used by farmers on the heavy London Clay soils of the Home Counties. About 10 tons per acre is a usual dressing; it should be spread before the winter ploughing begins so that it can be well worked into the soil. It then lightens the stiff soil and facilitates cultivation generally, and good root and other crops are usually

obtained. Farmers round some of the larger Scottish towns, *e.g.*, Glasgow, Dundee, Perth, and Aberdeen, use considerable amounts, probably even more than those round London. Uncrushed refuse is sold from Dundee, where the demand is stated to be greater than the supply: the 1921 deliveries are said to have been 39,000 tons. An important factor that greatly helps the consumption of this material in Scotland is that very favourable railway rates are in operation. In England the railway rates, generally speaking, are much higher than those for stable manure, and so it comes about that up to the present experience of this material is in the main limited to farmers on heavy land in the immediate vicinity of towns.

The amounts of ashpit refuse available over the country are very large. It is estimated that no fewer than 10,000,000 tons per annum are produced in England and Wales, while in London alone the production is estimated at 1,500,000 tons per annum. The towns might afford to spend some money on converting the material into fertiliser since at the present time they spend something like £6,000,000 per annum on collection and disposal.

Types and Composition of Refuse.—There are four types of refuse sent out from towns:—

1. "Dry refuse": the contents of ashpits.
2. Night soil: produced in towns where the pail system is used. It is dried and granulated and contains some 5½ per cent. nitrogen, 5½ per cent. phosphates and 2½ per cent. potash.
3. "Mixed refuse," *i.e.*, dry refuse *plus* night soil mixed in certain proportions. A 50 per cent. mixture offered at Rochdale contains 2.9 per cent. nitrogen, 3.6 per cent. phosphates (half being soluble and half insoluble) and 1.2 per cent. potash.
4. Street sweepings and other wastes.

Of these the street sweepings and the unmixed night soils are well known to farmers and are often easily disposed of. One of the large London districts disposes of its street sweepings at 10s. per ton on the barge. Night soil in the dry form, unmixed with ashes, is now sold by the Rochdale, Warrington and probably other corporations at a figure of about £7 per ton. If the methods used in these places were generally applicable to town and city conditions the problems arising out of the waste of sewage would be solved and the shortage of organic manures

on the farm would be greatly relieved; but we must expect these methods of conservancy to be superseded, and therefore we must turn to ashpit refuse as the only important unfailing source of this type of material.

In its crude form the refuse contains a small percentage of cans, bottles, etc., of no use on the farm but indeed constituting a nuisance. In the more progressive towns these are removed and the material undergoes a certain amount of sorting to remove coal, cinders, rags, bones, scrap metal, etc., for all of which a market can be found. Thus at Falkirk, where a good modern plant has been installed, the cinder amounts to some 35 per cent. of the total collection: it has a calorific value of 8,000 B.T.U. per lb., and after being taken out is used for steam raising at the local electricity station. Whatever the preliminary sorting treatment the remaining material is disintegrated to break up the larger and coarser materials. Three possibilities are then open:—

1. *Use without Modification.*—The material can be offered to farmers as it stands. It is in good physical condition for putting on to the ground and for lightening a heavy soil. Its composition, however, is not particularly good in spite of its smell. Improvement is effected by enriching with a certain amount of other waste matter, such as street sweepings, slaughterhouse refuse, stable manure, etc., and the final analysis comes out something like the following:—

Organic matter	25%—40%
Nitrogen...	0.4%—0.6%
Phosphoric acid (P_2O_5) ...	0.3%—0.5%
Equivalent to tricalcic phosphate ($Ca_3(PO_4)_2$)	0.7%—1.1%
Potash (K_2O)	0.3%—0.5%

It is sometimes the practice to compare these figures with those for stable manure, but as a matter of fact the two things are so completely different that no comparison on the basis of analytical data is possible. In the case of stable manure it is not difficult to arrive at some estimate of value from a careful study of the analytical data, as there is the possibility of ascertaining approximately what proportions of the various fertilising constituents have come from straw, fæces and urine, these being the three components. In the case of ashpit refuse it is impossible to say how much of the nitrogen comes from animal or vegetable refuse (where it would have a certain value),

TABLE I.—COMPOSITION OF ASHPIT REFUSE AS PREPARED BY CERTAIN TOWNS.

(Bottles and tins are removed, other wastes are usually added, and the material is crushed.)

	Gosforth	Bury	Sheffield			Falkirk		Southwark		Hove	Halifax†
			1	2	3	1	2*	1	2		
Moisture	25·0	34·4	2·84	2·89	2·77	...	14·20	30·74	28·98	...	40·8
Organic matter	23·1	13·6	28·6	34·2	37·5	.	20·51	32·04	26·96	...	21·7
Mineral matter	45·9	52·0	...		...	...	...	...	...	...	13·0
Nitrogen	0·50	0·55	0·7	0·57	0·67	0·39	0·56	1·21	0·70	0·56 to 0·84	2·13
Equivalent to ammonia... ...	0·60	0·67	0·86	0·70	0·82	0·47	0·68	1·46	0·86	0·68 „ 1·02	2·59
Phosphoric acid (P_2O_5)... ...	0·19	0·33	0·77	0·49	0·45	0·81	0·33	1·09	1·15	0·56 „ 0·82	0·56
Equivalent to Tribasic-phosphate of lime	0·41	0·72	1·68	1·07	0·98	1·76	0·72	2·37	2·52	1·22 „ 1·79	1·22
Potash (K_2O)	0·30	...	0·33	0·64	0·50	0·42	0·54	0·60	0·64	0·43 „ 0·60	...

* A full analysis was made of this sample and the following additional results were obtained:—

Silica	29·61	Sulphuric anhydride	0·95
Alumina	14·93	Soda	0·48
Oxide of iron	2·40	Combined water, carbonic acid, &c.	9·95
Lime	4·94	Potash soluble in water	traces
Magnesia	1·16		

† Mixture of night soil and prepared refuse. "Sand" is not counted in the mineral matter.

and how much from manurially worthless substances which may form a large part of the material. Something could be deduced if the organic matter (which of course includes much of the cinders) were divided in the analysis into easily combustible (vegetable and animal refuse), and not easily combustible material (cinders, etc.); but in no case can the analysis give very precise information.

It would be a mistake to underrate the fertiliser effect of the nitrogen, potash and phosphate in the material, but equally of course it would be inadvisable to put too high a value on them. So far as our present experience goes the chief value of the ash-pit refuse itself lies in its physical effect in lightening a heavy soil, and any manurial action it may have is to be attributed to any animal or vegetable refuse that may be present. The analysis does not easily show this. although a rough idea may be obtained from the nitrogen percentage. Inspection of samples delivered from London during the past season gave the impression that winter deliveries contained a larger percentage of cinders and a smaller percentage of fertilising animal and vegetable matter than the summer deliveries; hence probably the summer material would have rather a higher value to the farmer. The circumstance that much of the value of the refuse lies in its physical action makes it impossible to put any definite price on the refuse. It should of course be obtainable more cheaply than stable manure. On the other hand dressings of about 10 tons per acre have proved very useful on heavy land for root crops, cabbages, etc., and a farmer is really justified in spending a certain amount of money to obtain this result. If town stable manure costs about 12s. per ton on the farm it is probably not far wrong to say that town refuse would be worth, say, 6s. per ton on the farm, and more if the percentage of nitrogen rose above 0.6.

2. *Crushing*.—Some samples seen by the writer have been ground very finely. A certain amount of pulverisation is desirable, but it is not clear how far anything is gained by grinding too finely. The material of course is not like basic slag or mineral phosphate: it does not dissolve in the soil solution, and only the vegetable matter and the bones can gain in value by fine grinding. The actual ashes may even lose in value.

3. *Addition of Richer Material*.—In some of the northern towns it is found possible to add a considerable proportion of night soil in addition to street sweepings, cattle market manure, slaughterhouse refuse and stable manure. An excellent fertiliser

is thus obtained, containing one or more per cent. of nitrogen. One of the best illustrations in England is furnished by Gateshead, where the vigorously managed Cleansing Department is taking full advantage of the various available wastes. The Superintendent of this Department sends the following particulars of the fertiliser made by the town authorities from the refuse. The tins, bottles, glass, etc., are removed, stable manure, slaughterhouse refuse, earth-closet material are added, and the whole passed through a pulverising machine and broken up to pass through a $\frac{5}{8}$ grate. As 90 per cent. of the houses in Gateshead are of the old earth-closet type the house refuse contains a considerable proportion of human excretions. It is not surprising therefore that the manure finds a ready sale.

The material is offered at Gateshead at 2s. 6d. per ton. It is delivered in 5 tons lots, and on a farm 5 miles away, with the occupier of which the writer has discussed the matter fully, the price works out at 5s. 6d. per ton, the steam wagons taking the material where possible into the actual field which is to be treated. It has given good results on roots, and it improves the physical texture of the soil though it still remains to be seen whether the material lasts as well as farmyard manure. On the farm in question farmyard manure is estimated to cost 14s. per ton.

An actual test was made at Cockle Park in 1921 to compare town refuse with farmyard manure. Both were applied at the rate of 15 tons per acre to a swede crop: the Gateshead refuse gave 21½ tons of swedes to the acre, and the farmyard manure gave 25¼ tons. The season was dry and therefore more favourable to farmyard manure than to town refuse.

The enrichment of the refuse is shown by the fact that the nitrogen content runs as high as 1 per cent., whilst the samples of unfortified town refuse contain only about 0.5 per cent. It is understood that some 30,000-35,000 tons of the material were sold to farmers during the past season and that deliveries were effected as far south as Thirsk.

An even richer fertiliser is now being prepared at Halifax (Table I) where it is understood the Corporation are contemplating the erection of special mixing plant.

Another instance of successful enrichment is afforded by Dundee, where cattle market and slaughterhouse wastes and offals are incorporated with the refuse, and this circumstance, together with the favourable railway rate largely explains the high con-

sumption which the authorities of that city have managed to obtain among local farmers.

It has been proposed to add soot to the town refuse, but this would not be a sound procedure. During the War an enterprising person offered 100,000 tons of enriched town refuse free on rail at £3 per ton: the composition of the mixture was:—

Total nitrogen ..	1·22%	Potash (K_2O) ...	0·80%
Ammoniacal nitrogen	0·52%	Phosphoric acid (P_2O_5)	0·30%

This of course would have been a very dear fertiliser. The figures are quoted as showing how uniform the material is in composition: if we deduct the ammoniacal nitrogen (which is mainly soot) from the total we arrive at a composition which is very similar to the figures given in Table I, viz., nitrogen 0.7 per cent., phosphoric acid (P_2O_5) 0.3 per cent., potash (K_2O) 0.8 per cent.

These modern prepared wastes are well worth attention by farmers, and trial lots may usefully be put on the root and cabbage land, and possibly also used for hay on stiff clay soils. A test has been started at Rothamsted, and other experimental farms might consider the possibility of arranging for trials.

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THE CLYDESDALE.

A. MacNeilage.

The Clydesdale is the Scottish breed of draught horses. Its name indicates its origin. Clydesdale is the old name for the county of Lanark, through which flows the river Clyde. The Clydesdale is the horse that was originally moulded into its established type and form by farmers holding land in the valley of the Clyde. Its fortunes, since the middle of the eighteenth century at least, have been identified with the Royal burgh of Lanark. There in the eighteenth and the earlier part of the nineteenth century annual fairs were held at which mobs of young colts and fillies were sold to dealers and drafted into England. Another old-time fair was held at Biggar, higher up the Clyde Valley, and there also was done a notable trade in young Clydesdales. Now for thirty years past in the town of Lanark, under modern conditions, most extensive auction sales of Clydesdales—mainly yearlings and two-year-olds—have been held. Lanark and Clydesdale are emphatically the home of the Scottish breed of draught horses.

How farmers in the area referred to first came to fix their

minds on breeding a heavy horse is not clear. There is reason to believe that a useful type of carrying horse had long been associated with the area and no doubt the advance in road-making, before the development of railway traffic, gradually led men to aim at producing a heavier horse better adapted for draught than for carrying. Tradition assigns influence in increasing weight to the use of one or two Flemish stallions by the sixth Duke of Hamilton (1742-1758), and by John Paterson, a farmer in Lochlyoch parish of Thankerton, about the years 1715-1720. John Paterson and his stallion are authentic, and the late Lawrence Drew—a noted man in his time, and a great horse-breeder—credited the ownership of one Flemish stallion to the sixth Duke of Hamilton.

At a later date—about the year 1780—a horse called Blaze, owned by Mr. Scott, a farmer in Carnwath, admittedly greatly improved the native breed. Mr. Scott was an ancestor of Mr. James Weir, Sandilands, Lanark, President of the Clydesdale Horse Society for the current year (1922-23). Blaze was purchased in Ayrshire but whence he came to Ayrshire is not clearly known. It was said by some that he came from England.

A notable breed of mares was owned by the family of Somerville, on Lampits farm in Carnwath parish, where there is a ford across Clyde. These Lampits mares were reputed to be of the Lochlyoch stock of John Paterson, and to one of them has been assigned a very powerful influence in the development of the modern Clydesdale. She was bought at a sale at Shotts Hill Mill in 1808. It may be doubted whether the links which bind the modern Clydesdale to this particular mare are quite as clearly established as the writer of the Introductory History to the Retrospective Volume of the Clydesdale Stud Book supposed—but her influence was great—and Glancer, *alias* Thompson's Black Horse 335, was unquestionably a well-known and much valued sire. What is clearly and incontrovertibly established is that the Clydesdale as bred in Aberdeenshire and the north, in Galloway in the south, in the Kintyre peninsula, in Ayrshire and Renfrewshire in the west, and in Cumberland in the north of England, is descended directly from Lanarkshire horses and mares purchased during the first quarter of the nineteenth century in the Upper Ward of Lanarkshire or Clydesdale. The links that bind these sections of the Clydesdale breed to the fountain-head are clearly defined and historically sure.

A very famous sire which flourished about the year 1840 was Clyde, *alias* Glaneer 153, known popularly as "Fulton's ruptured horse." An old farmer who remembered him well told the writer that he was a "mickle, strong horse." Seven stallions got by him are recorded and all of them were similarly impressive and prepotent sires. Their influence was widespread. Other notable fountain heads were Rob Roy 714, Old Clyde 574, Largs Jock 444, Old Farmer 576 and Pringle's Young Clyde 949. These can all be connected with Lanarkshire, but cannot be proved to have been connected with the Lampits mare, or the Lochlyoch race. In areas widely apart they left an indelible impression and were largely instrumental in making the Clydesdale the Scottish breed of draught horses.

Breeding Influences.—Two agencies exerted a powerful influence in developing the breed—the inauguration of competitive exhibitions by the Highland and Agricultural Society in the early twenties of last century; and the system of hiring stallions by district societies, of the existence of which there is evidence as early as 1832. By the former a standard of merit was set up and by the latter the best horses were distributed through the country. These two influences continue to be exerted to a surprising extent. At the beginning of 1919, 180 stallions had been hired for service in 1920, 76 had been hired for 1921, 10 had been hired for 1922 and 3 had been hired for 1923. With such a system of hiring generally in operation, it is not difficult to understand how one type of horse came to be developed through the whole Clydesdale area, which may be said in a general way to embrace the four northern counties of England and the whole of Scotland.

Standard and Type.—A very marked change has taken place in the type aimed at by breeders of Clydesdales. The general principles, which have never been departed from, are that wearing properties of feet and legs are of supreme importance in the draught horse, and that quality, by which is meant the capacity for wearing well, is of greater importance than mere weight avoirdupois. Experience has shown that the horse which wears longest may be and usually is the horse which takes the longest time to come to maturity. While these two general principles have never been departed from, a considerable modification of emphasis has taken place from time to time. The Clydesdale of the first quarter of the nineteenth century was a handsome well-built animal, with finely carried head and neck, high at the withers, with sound open hoof-

heads, but not carrying much hair on the legs and altogether minus the modern "spat" as it is called—the fringe of hair spread over the hoof-heads—and giving the impression of great obliqueness of pastern joint and fetlock.

During the dominance of the "Ruptured Horse" (153) and his seven sons—a heavier, more massive, and more lorry-like type was fancied and bred. The soundness of the feet and the open hoof-head were insisted on, but there was more hair on the legs, the obliqueness of the pasterns was not so much insisted on, and on the whole the horse fancied was decidedly a "big" horse.

In the early sixties came the demand for better action and greater gaiety of carriage and movement. The dominant influence in creating this demand was Sir Walter Scott 797 which won supreme honours at the Royal International Show at Battersea in 1862. This type and the demand for style and action continued to maintain an ascendancy all through the long career of Prince of Wales 673 (1866-1888), a grandson of Sir Walter Scott 797.

In 1872 one of the greatest sires the breed has ever known, Darnley 222 (1872-1886), was foaled at Keir. His dam and the dam of Prince of Wales 673 were both celebrated showyard mares, and both were by Samson 741, one of the most impressive of Clydesdale sires. The produce of Prince of Wales 673 and Darnley 222 blended well, in so far as producing showyard winners is concerned, but a general lack of size and weight was noticeable. The orthodox blend was Prince of Wales and a Darnley filly, and for many a day Prince of Albion 6178, bred on these lines, held the record, having been sold when a two-year-old stallion for £3,000. Another, Prince Alexander 8899, bred on similar lines, held the record for a foal, having been sold for £1,200. He was champion at the Highland and Agricultural Society's Show at Dundee, in 1890, when a yearling colt, beating amongst others Prince of Albion 6178. What this blend demonstrated was the incomparable merit of daughters of Darnley 222 as dams of prize stock.

Yet something almost akin to accident demonstrated that the influence of Darnley was to be much greater through his sons. This was seen when his grandson Sir Everard 5353 appeared. His sire was Top Gallant 1850 (1877-1886) a big son of Darnley with incomparable feet, and his dam was by a son of Prince of Wales 673. Sir Everard proved a most valuable sire. He was himself a weighty, big horse, and exhibited the balance of

quality and weight which was in risk of being lost when the Prince of Wales-Darnley cross was in the ascendant. Since the days of Sir Everard 5353 (1885-1898) his race has dominated the breed. He sired Baron's Pride 9122 (1890-1912) the soundest and best wearing sire the breed has produced. His feet and limbs were perfect in respect of wearing qualities. His limbs in the last years of his life were as "sweet" and clean and the bone as sharply defined as when he was champion at the Highland and Agricultural Society's Show at Aberdeen, in 1894. The Clydesdale breed in so far as the showyard is concerned is dominated by the influence of Baron's Pride. His grandson Dunure Footprint 15203 is the most prolific known sire of the breed. His service fees for several seasons have been £60 payable at service, and £60 additional for every mare left in foal.

On the Prince of Wales 673 side the most outstanding modern sire has easily been Hiawatha 10067 (1892-1915). He was got by Prince Robert 7135, a son of Prince of Wales 673, and bears the record of being the most successful show horse of the breed. His daughters mated very successfully with Baron's Pride 9122 and Baron's Pride's daughters mated very successfully with Hiawatha 10067, but while Baron's Pride was the ideal typical Clydesdale with faultless feet and limbs and well ribbed, with a beautifully set head and neck and high withers, albeit rather light in the thighs and lacking muscular development there, Hiawatha 10067 set a new type in Clydesdales. He was himself a "tall" horse. He came very slowly to maturity and always appeared a little "leggy." He had perfectly formed hind limbs and bones which looked like ivory. No one of the older race of Clydesdale fanciers or owners, that is the men of about 1850-1900 ever thought of speaking of a "tall" horse; their ideal was ever the "thick" horse—big when lying down. Hiawatha made the "tall" horse popular, and to-day a slowly-maturing colt with broad, flat, thin, clean bones is not found fault with, even should he be a little "on the leg." Granted he is out of the short-legged, deep-ribbed, sound-footed and sound-limbed type of mare, he is more favoured by judges than the short-legged thick colt which is pronounced "old fashioned."

Popularity of the Breed.—The Clydesdale has for well nigh a century been in demand for export. Hence his prominence especially in Australia, New Zealand and Canada. During the years from 1850 to about 1880 a fair number of the best

stallions and mares were annually shipped to those countries. In 1880 a big trade in second-class animals began with the United States and lasted for about a dozen years. It was an unfortunate trade, as too many animals of secondary merit were shipped. During the years immediately preceding 1914 there was an extraordinary export trade which reached high-water mark in 1911, when the number of export certificates issued by the Breed Society was 1,617. Since the War exports have been few in number, but have included some of the best stallions and mares of their years, including Cawdor Cup Champion winners.

The Clydesdale holds the record among draught breeds for high prices realised at public auction. Baron of Buchlyvie 11263 was sold in this way in Ayr market in December, 1911, for £9,500; in October, 1915, his son Bonnie Buchlyvie 14037 was sold at the Seaham dispersion for 5,000 guineas; the brood mare Dunure Glad Eye 39839 was sold at Dene House dispersion sale in April, 1919, for 1,850 guineas; at the Lanark sales in October, 1920, the yearling colt Record 20157 was sold for £3,400. The following are some of the outstanding averages realised at auction sales during the better part of the past half century:—

Date.	*Place.*	*Number.*	*Average Price.*		
20th October, 1876	Knockdon - - - -	22 head	£209	15	2
11th October, 1906	Blacon Point (dispersion) -	14 females	£206	10	6
7th October, 1915	Seaham Harbour (dispersion)	100 head (both sexes and all ages)	£211	17	4
6th March, 1917	Dunure Mains (draft) - -	47 head	£323	18	8
5th March, 1918	Banks Stud (dispersion) -	25 stallions	£557	19	5
14th January, 1919	Dunure Mains (dispersion) -	13 stallions	£1,676	7	4
8th October, 1920	Boquhan (dispersion) - -	40 (mostly females)	£317	8	3
11th October, 1920	Dunure Mains (dispersion) -	28 head	£1,312	2	1
13th October, 1920	Farleton (dispersion) - -	19 (mostly females)	£408	13	8

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LABOUR ON THE FARM.

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SINCE the year 1908 a large amount of statistical data bearing on the various aspects of farm costs has been accumulated in the Department of Agriculture of the University of Leeds, and a systematic investigation of the records may be interesting and instructive. More or less complete records on at least eight farms can be traced back continuously to 1912, while at the present time 52 Yorkshire farms of varied size and type are being costed through the Department.

During the past year the bill for manual labour has been found to vary on the different farms from £1 8s. 6d. to £17 2s. 4d. per acre. Such wide limits naturally lead one to ask what are the varying factors which have contributed to bring about such widely varying labour costs in the same year? Was the one farm being farmed efficiently? Was the management justified by results in so large an outlay on manual labour on the other farm? How much per acre ought a farmer at the present time to be spending on labour?

During the time that the investigations have been carried out, the labour bill on one small holding of 16 acres has been found to increase from £52 in the year ending 31st December, 1912, to £289 18s. 1d. for the year ending 31st December, 1921. Was labour in pre-war days, or in the early days of the War, before the institution of the Agricultural Wages Board, getting its fair share of the output from the farm? Have the awards of the Wages Board, and the subsequent recommendations of the Conciliation Committees with regard to labour, been reasonable and fair, or is labour at the present time getting an undue share of the net returns from the farms? The records available can suggest answers to practically all of these questions.

Influence of the War on the Labour Bill.—In Table I are shown the yearly variations in the labour bills of 4 different types of Yorkshire farms, these variations being typical of those found on the other farms of which available records date back to pre-war days. It will be seen that with the outbreak of the War and the subsequent rise in prices the wages bills on the farms remained with very few exceptions fairly stationary until in

1917-18 the institution of the Wages Board and the successive Wages Board Orders tended to raise them higher and higher. In each case the maximum was reached in the year 1920-21, and with the disappearance of the Wages Board, and the subsequent advent of the Conciliation Committees, there has been a slight drop, though the wages bill in 1921-22 in no case met with by the authors fell to the level of the year 1919-20.

TABLE I.

ANNUAL VARIATIONS IN THE LABOUR BILL OF 4 YORKSHIRE FARMS.

Year	H. £	C.M. £	D. £	M. £
1911-12	52	786	324	965
1912-13	74	796	355	972
1913-14	83	829	417	971
1914-15	77	825	584	911
1915-16	98	808	570	1,153
1916-17	99	758	604	1,274
1917-18	102	831	664	1,694
1918-19	224	1,336	692	1,755
1919-20	279	1,650	991	2,292
1920-21	309	2,118	1,254	2,632
1921-22	290	1.841	1,107	2,487

In Fig. 1 the annual variations of the labour bills of these farms are plotted for the sake of comparison on an acreage basis.

FARM H. is a small holding of 16 acres, on the outskirts of an industrial town, and is given up entirely to milk production.

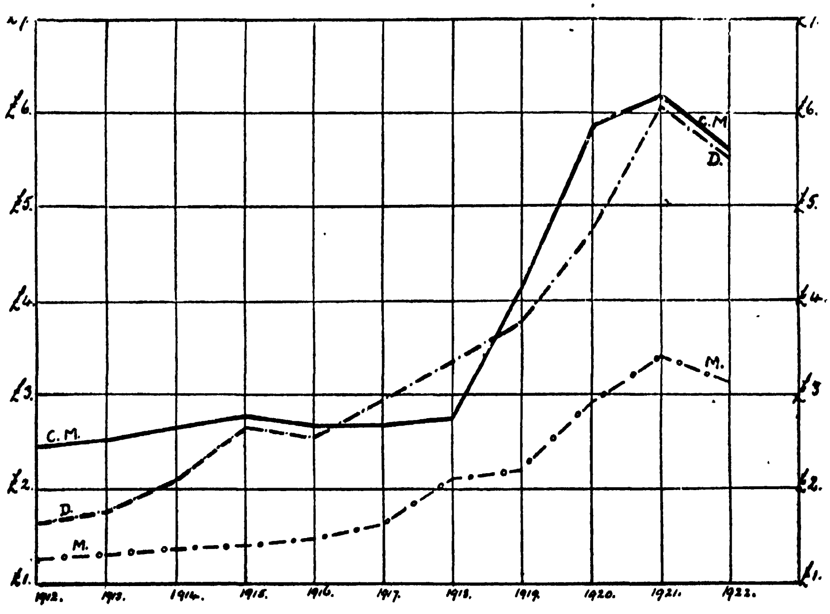

FIG. 1.--Annual Variations in Labour Bill per acre.

C.M. is a mixed farm of just over 300 acres, specialises in pigs, but breeds and rears cattle and produces milk, the milk being mainly converted into butter and cheese. Some of the land is good potato land, though good corn crops, particularly wheat, can be grown.

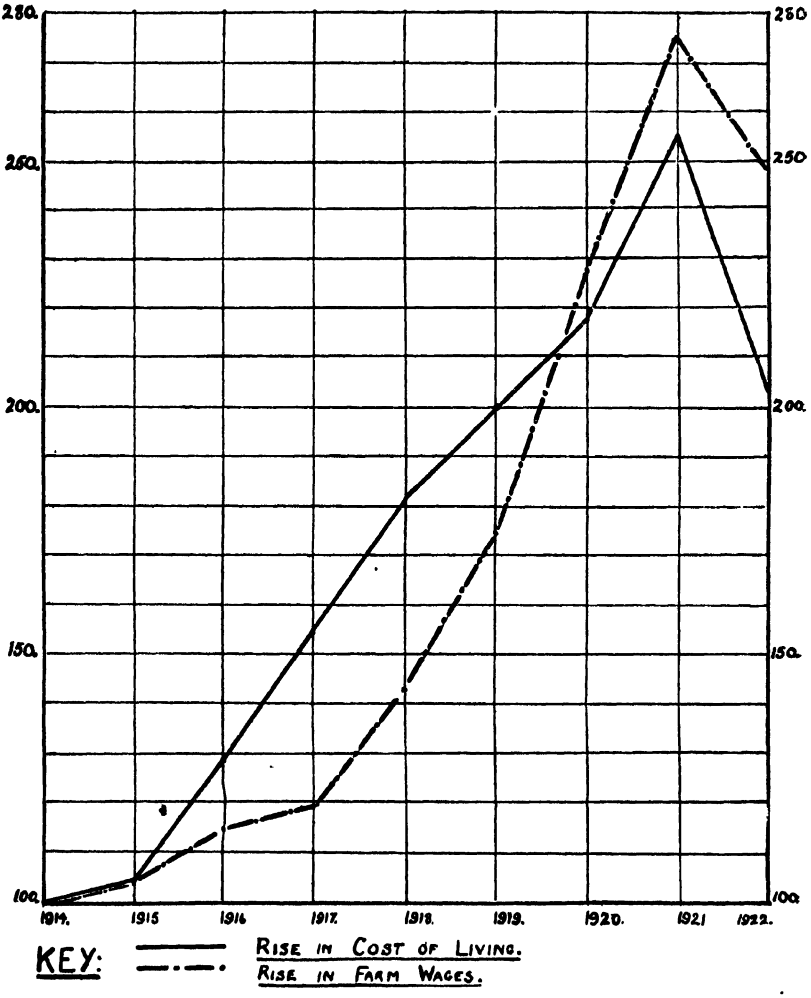

FIG. 2.—Correlation of Rise of Farm Wages with Cost of Living.

D. is a mixed farm of just over 200 acres, which started to develop the milk industry at the outbreak of the War. It could be looked upon as barley rather than wheat land.

M. is a farm of 786 acres, two-thirds of which is grass, mainly sheep land, the arable land being light and given up largely to potatoes and rye.

As far as Yorkshire as a whole is concerned, the Wages Board awards may be briefly summarised as follows:—

Date of Award	For	Minimum wage per week	Hours Summer	Hours Winter
12th Sept., 1918	Adult Labourer	35s.	54	51
21st Oct., 1918	Stockmen	41s.	Customary Hours.	
6th Oct., 1919	Adult Labourer	41s.	50	48
19th April, 1920	All Classes	45s.	50	48
23rd Oct., 1920	„ „	49s.	50	48

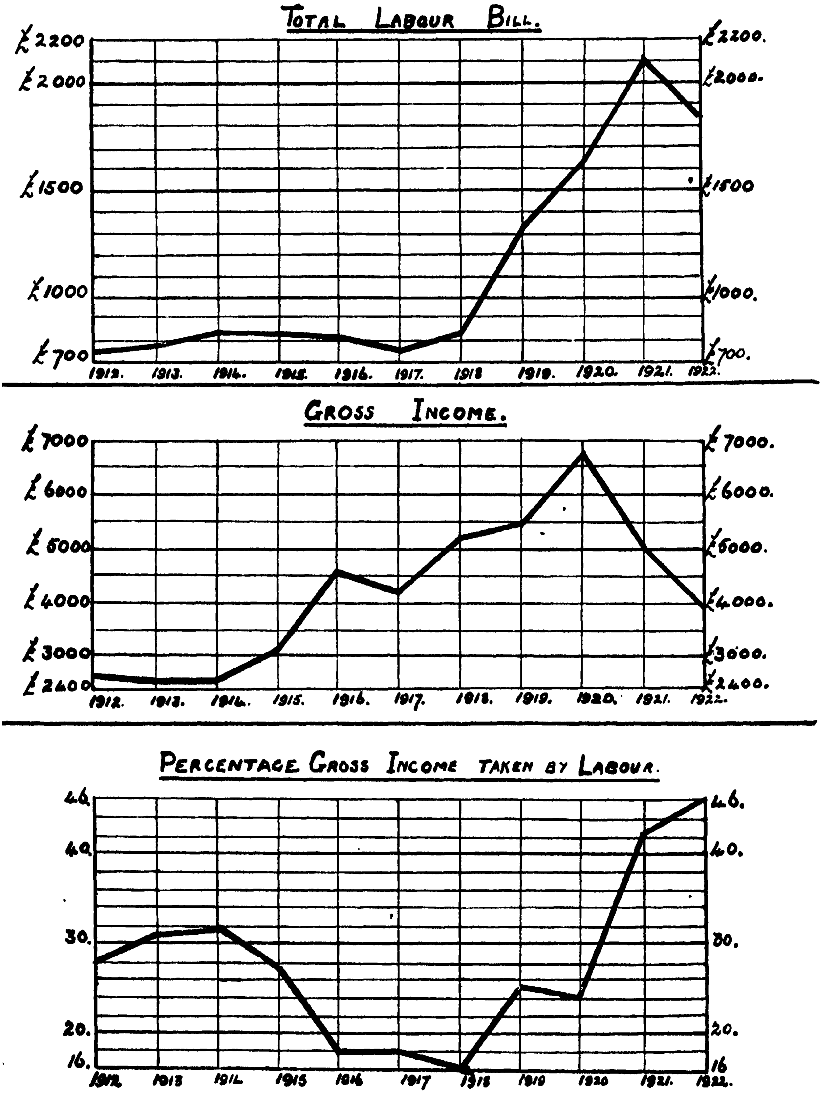

FIG. 3.—Relation of Cost of Labour to Gross Income.

The recommendations of the Conciliation Committee as from 1st October, 1921, for a 50-hour week, have been for the East Riding, 39s. to 26th November, 1921; for the North Riding, 40s. to 26th December, 1921, and 37s. to 1st March, 1922. The average at the present time is approximately 35s.

In pre-war days, the average farm labourer would receive as wages approximately 20s. per week, and the Wages Board award of 23rd October, 1920, theoretically increased the wages bill on the farm to approximately two and a half times its pre-war figure; but the limitation of hours and the necessity of employing more hands or the working of overtime by the existing staff actually increased the wages bill in most cases to three and in some cases to four times its pre-war figure.

On the four farms mentioned above, the actual effect of the shorter hours worked as a result of the operation of Wages Board Orders is shown by the following table:—

TABLE II.
NUMBER OF MEN EMPLOYED.

Farm	Year ending April 6th										
	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922
H.	1	1	1	1	1	1	1	1	2	2	2
M	16	16	16	16	16	16	17	17	15	14	14
D.	4	4	5	5	5	6	6	6	6	7	7
C.M.	11	11	11	11	11	10	10	11	12	14	14
	32	32	33	33	33	33	34	35	35	37	37

It will be seen that the number of men employed on the 1,300 acres concerned rises from 32 in pre-war days to 37 in 1921—an increase of nearly 16 per cent. Expressed differently, it would seem that the reduction in hours worked necessitated the employment of 7 men in 1921 to accomplish the work performed by 6 men in 1912.

The wisdom of the awards can be judged in one of two ways. It may be claimed that wages should rise in proportion to the cost of living, or, alternatively, that the amount paid in wages by any industry must be finally determined by what the industry can afford to pay.

It is interesting therefore to compare the wages actually paid on the various farms when viewed from both these standpoints.

Comparison of Wages with Cost of Living.—In Fig. 2, an attempt has been made to correlate the wages actually paid on all the farms whose records go back to 1914, with the varia-

tions in the cost of living. The wages bills on all the 12 farms have been totalled each year, and reduced to a figure which corresponds to a standard of 100 for the year ending 31st March, 1914. The comparative costs of living have been deduced from the index figures published each month in the Labour Gazette, taking the prices prevailing in 1914 as 100, and adding to that each year the average percentage increase during the period 1st April—31st March.

TABLE III.

COMPARISON OF WAGES BILLS IN YORKSHIRE WITH COST OF LIVING.

Year	Comparative Wages Bill	Comparative Cost of Living
1913-14	100	100
1914-15	104	104
1915-16	114	129
1916-17	119	154
1917-18	143	182
1918-19	174	200
1919-20	227	218
1920-21	275	255
1921-22	249	203

It will be seen that up to 31st March, 1915, the slight increase in wages on the farms in question coincided exactly with the slight increase in the cost of living. From then up to the end of March, 1918, the cost of living rose much more quickly than the rise in wages, by which time wages had risen 43 and the cost of living 82 per cent. Judging from this standpoint, the Wages Board was not appointed a day too soon.

From then up to March, 1921, farm wages rose more rapidly than the cost of living, the two curves crossing approximately in January, 1920.

When the Wages Board was dissolved in 1921, and Conciliation Committees were set up under the Corn Production Acts (Repeal) Act, 1921, the percentage increase in the wages paid on the farms was approximately 20 points above the percentage increase in the cost of living. By April, 1922, when the cost of living was falling more quickly than the wages on the farms, there was a difference of 45 points in favour of the increased wages.

It would appear therefore that while the Wages Board Awards up to April, 1920, were more than justified, the last increase in October, 1920, could hardly be looked upon in the same light. It is, however, only right to bear in mind that what the farm worker, looking at the matter from his own point of view, might

consider he had lost up to January, 1920, owing to the failure of the rise in his wages to keep pace with the rise in the cost of living, would only be recovered by April, 1923, provided his wages and the cost of living remained stationary at the present level, or both fell in the ratios in which they have fallen since the appointment of the Conciliation Committees.

According to the index figures as published in the Labour Gazette, the cost of living reached its maximum in November, 1920, when it stood at 176 points above the pre-war level. Since then it has dropped fairly consistently until by April, 1922, it stood only at 88 points above the standard. It is interesting therefore to consider how closely the rise and subsequent fall in agricultural wages agreed with those which obtained in other industries.

Rise of Agricultural Wages Compared with those of other Industries.—Briefly it may be stated that as compared with those that have obtained in other industries agricultural wages were slow to rise, and have again been slow to fall, that while as far as can be traced the maximum increase of wages in the agricultural industry has only been exceeded by the maximum increases in the wages of the building trades labourers and railway workers, the increases which prevailed in March, 1922, were only approached by those which prevailed in the printing trade; and that while at that time agricultural wages stood at 148 per cent. above the pre-war level, wages in the woollen trade were 95 per cent., in the cotton trade 61 per cent., and miners' wages only 45 per cent. above pre-war level.

While in an article of this description it is impossible to quote the wages variations in all the 24 industries, it appears that from the agricultural worker's point of view the rise in agricultural wages with the rise in the cost of living will bear comparison with the increase granted in any other industry.

In the comparisons which have been made it must, however, be remembered that the figures relate to percentage increases and not to actual increases. Owing, then, to the low pre-war rate of farm wages, any actual increase obtained is reflected as a greater percentage increase than would be the case in other industries with a higher pre-war rate of pay.

It has already been suggested that while from the labour point of view wages should be determined by the cost of living, yet the employer demands that they should be determined by what the industry can afford to pay. An estimate of this latter

sum can be obtained by a study of the varying *Gross Income* derived from the industry on certain farms, or, better still, from a study of the varying *Net Output*.

Relation of Cost of Labour to Gross Income from Farming.— The graphical representation in Fig. 3 illustrates the relation of labour costs to gross income.

It will be seen that on this farm of 312 acres, the wages from 1914 to 1918 remained approximately constant, though the gross income from the farm had during that time been more than doubled. Up to the intervention of the Wages Board, the men were reaping no advantage from the increasing prosperity of the farm. As rents were remaining constant, presumably it was the farmer who was reaping the whole of the benefit. If this is typical of other farms, it looks as if in justice to the worker the Wages Board might with advantage have been set up at least two and probably two and a half years earlier. Continuing the curves in Fig. 3 it will be seen that the gross income derived from the farm reached its maximum in 1920.

During the next year, in spite of the fact that with falling prices the gross income from the farm was rapidly falling, the successive awards of the Wages Board were steadily increasing the wages bill. During the last year of the series, with the advent of the Conciliation Committee, wages on the farm fell, but not at all so sharply as the fall in the gross income derived from the farm. On this particular farm, during the year 1921-22, 46 per cent. of the total gross income was required to pay the labour bill alone.

Looking at the bottom graph in Fig. 3, it will be seen that during the years 1915 to 1919, and possibly up to 1920, labour was apparently not getting its fair share, but that from 1920-1922 it was certainly getting more than its share. Provided we had taken the 1914 figures as our standard and labour on the farm had been prepared to accept as its share the proportion which the farm could apparently afford to pay, it would have received as wages in—

1914-15	£870	instead of	£825	actually paid.
1915-16	1,340	" "	808	" "
1916-17	1,220	" "	779	" "
1917-18	1,560	" "	834	" "
1918-19	1,600	" "	1,336	" "
1919-20	2,000	" "	1,650	" "
1920-21	1,520	" "	2,118	" "
1921-22	1,200	" "	1,841	" "

In other words labour might complain that up to 1920 it had received as wages £2,300 less than what it might perhaps with reason have claimed as its share, but might congratulate itself that during the years 1920-21 and 1921-22, it had been paid £1,200 more than its share.

These figures have been arrived at by a comparison of the wages and *gross* income from the farm. It is, however, fairer to try and get a comparison betweeen wages and net income, or even net output, the net output being the fund available for payment of profits to the farmers, rent to the landlord and wages to the men.

Relation of Cost of Labour to Net Output in Farming.—According to Orwin's figures,* which agree fairly closely with those we have obtained in Yorkshire, in 1913-14 labour was taking 33 per cent. of the net output, the farmer 45 per cent.; in 1916-17 labour took 27 per cent., the farmer 61 per cent. In 1919-20 on 11 Yorkshire farms of 2,738 acres, on which the net output averaged £9 4s. 7d. per acre, labour took 49 per cent.; in 1920-21, on 19 Yorkshire farms of 4,471 acres, on which the net output was £5 12s. 2d. per acre, labour took 78 per cent., and in 1921-22 on the 29 farms in the same county comprising 6,515 acres, whose full accounts are at present completed, labour took 84 per cent. of a total net output of £4 4s. 9d. per acre. Judged from the standard of the net output, from the outbreak of the War up to 1917-18 labour was not, as has before been pointed out, receiving its fair share of the increased prosperity of the industry, but for the last two years at least it has been getting more than the industry could reasonably be expected to bear.

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* *Journal of Royal Agricultural Society*, Vol. 82, p. 155.

GROUND MINERAL PHOSPHATES AS MANURES.

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Dr. Aitken's Experiments in Scotland, 1879-1889.—Trials of ground mineral phosphates were made for many years at the Pumpherston Agricultural Experimental Station of the Highland and Agricultural Society of Scotland, by the late Dr. Aitken, Chemist to the Society. The results are now of special interest when ground mineral phosphates are again being offered to farmers in considerable quantity. Dr. Aitken conducted trials for seven years previous to 1886, and found these ground mineral phosphates very erratic in their action. He concluded* that their utility varied with the softness of the mineral, and with the fineness of grinding. The phosphates which produced the best results were Carolina land phosphate, Belgian phosphate, and Aruba phosphate, but these were also the finest ground. He reported that they produced better results in wet than in dry seasons, and that they acted best on land rich in organic matter. He also found that phosphatic guano and precipitated phosphate acted better than ground mineral phosphates, but that bone ash did not act so well. He concluded that superphosphate was the most reliable kind of phosphate for general use, but that with a more thorough system of grinding the dissolving of phosphates might be dispensed with.

In the following year Dr. Aitken recorded† most valuable results on the value of mineral phosphates of different degrees of fineness. In 1886 he conducted at Pumpherston trials of basic slag containing 40 per cent. phosphates (then a new manure), and the following ground mineral phosphates:—Curaçao, 87 per cent. phosphates; Canadian, 59 per cent. phosphates; Carolina, 57 per cent. phosphates; and Belgian, 40 per cent. phosphates; and also of superphosphate, 28 per cent. soluble phosphates. The crop was turnips and the plots were one-twentieth of an acre in area. In all cases the plots received (per acre) 100 lb. of sulphate of ammonia and 60 lb. of sulphate of potash (50 per cent. potash). He found, although all the ground mineral

* *Transactions* of the Highland and Agricultural Society, 1886, p. 351.
† Do. do. , 1887, p. 245.

phosphates appeared to be finely ground, that less than 50 per cent. of each would pass through a sieve of 120 wires to the linear inch. He therefore had all these mineral phosphates sifted, and tested each of them as:--

(1) Sifted—all passing through a No. 120 sieve, and

(2) Unsifted—from 40-50 per cent. passing through a No. 120 sieve.

The same amount of phosphoric acid (about 100 lb. an acre) was applied of each, so that the quantities per acre were: Superphosphate, 800 lb.; Basic Slag, 560 lb.; Curaçao, 260 lb.; Canadian, 360 lb.; Carolina, 400 lb.; and Belgian, 560 lb.

On the average the weights per acre of the turnips were:—

	Tons.	Cwt.
No phosphates	9	9
Superphosphate	11	9
Basic slag	11	13
Mineral phosphates sifted	11	17
Mineral phosphates unsifted	10	18

He summed up the results thus:—

"1. Ground mineral phosphates are the more active the more finely they are ground.

"2. When ground as finely as to pass through a sieve of 120 wires per linear inch, they are nearly as active as superphosphates.

"3. The nature of the phosphate is of much less importance than the fineness to which it is ground.

"4. Basic slag is at present (1886) the most finely ground and the cheapest phosphate on the market."

Dr. Aitken conducted such trials for many years, not only at Pumpherston, but on farms in all parts of Scotland. Many of his trials with ground mineral phosphates were disappointing and he believed that the lack of fineness of grinding caused a number of the poorer results. The advent of basic slag, the good results it gave, the fact that it could be readily obtained ground to a standard fineness, and also that phosphates could then be obtained at a cheaper cost per unit in this than in ground mineral phosphates, all tended to discourage further experimental work with ground mineral phosphates at that time.

In 1889 Dr. Aitken stated that a unit of phosphate of lime cost 1s. 1d. in mineral phosphates and only 11d. in basic slag. In 1896 he put their relative costs at 8½d. and 1s. 2½d. Since that time the phosphates have usually been at a lower cost per unit in mineral phosphates than in basic slag. There were for some time, however, abundant supplies of basic slag, and

very little experimental work was done with mineral phosphates. Quotations for most grades of basic slag are now about 2s. 5d. per unit of phosphate of lime at the farmer's nearest station, whereas in the north of England finely ground North African phosphates, containing 60 per cent. of phosphate of lime, and guaranteed that 80 per cent. will pass through a No. 120 sieve (14,400 holes to the square inch) are now offered at about 1s. 4d. a unit at the farmer's nearest station. The great alteration in the relative commercial values of these two phosphatic manures makes the late Dr. Aitken's results now of great interest and value, and especial attention should be given to his advice, repeatedly and emphatically made, that mineral phosphates applied to the land are of use as manures only when they are ground to the finest flour.

Trials at Cockle Park, 1911-14.—Trials of various phosphatic manures for three years' seeds hay were made at Cockle Park in the three years, 1911-1913, 10 cwt. per acre of high-grade basic slag, or an equivalent amount of phosphates in other dressings, being applied when the corn crop was harvested. On the average of the three following years the amounts of hay produced per acre were :—untreated plot, 33¼ cwt.; basic slag plots, 38¾ cwt. to 41¼ cwt.; bone meal, 40¼ cwt.; Tunisian rock phosphate, 37½ cwt.; and Belgian rock phosphate, 40¼ cwt.

Similar trials were made for the three years, 1912-14, when the average crops of hay per acre for the three years were :— No dressing, 33¼ cwt.; basic slag plots, 39½ to 41 cwt.; bone meal, 37 cwt.; Tunisian phosphate, 39 cwt.; and Belgian rock phosphate, 40 cwt. (See *Guide to Cockle Park*, 1917.)

These and other trials showed that ground mineral phosphates gave results practically equivalent to basic slag.

Trials at Wylam-on-Tyne, 1914.—Trials of mineral phosphates on the park at Close House, Wylam-on-Tyne, were commenced in March, 1914, when basic slag, Belgian phosphate and Algerian phosphate were applied to different areas of the park, 200 lb. an acre of phosphoric acid being applied in each case. A careful inspection 2½ years later showed on all the treated areas a marked improvement due to these manures. The pasture on the untreated area was valued at 25s. an acre and that on the remaining areas at 45s. an acre. The results showed that when mineral phosphates are as finely ground as basic slag the phosphates they contain may be about equally effective.

Trials in Essex, 1915.—Dr. Robertson commenced trials in Essex in 1915 with mineral phosphates and basic slag. The results of these trials are given in the September issue of this *Journal*, page 519. He concludes that as a source of phosphate for the manuring of grass land, the value of mineral phosphates is very close to that of high-grade basic slag, and that, of the various types of rock phosphate, Gafsa (a North African phosphate) seems to be the most suitable for direct application.

Trials at Cockle Park, 1917.—In October, 1917, 11.1 cwt. per acre of high-grade basic slag and 8.3 cwt. per acre of Tunisian phosphate were applied to small plots of old pasture of a poor character at Cockle Park. Each dressing contained 200 lb. phosphoric acid. The dressings were repeated in October, 1920. A recent inspection of these plots shows a marked improvement over the untreated plots, and it is difficult by observation to say which have been most effective.

It is again urged that the greatest importance should be attached to fineness of grinding. The eye is not a safe test in judging of this fineness, so that samples should be obtained before purchase for examination and guarantees as to fineness of grinding. It is usual to guarantee that 80 per cent. of basic slag and other finely ground mineral phosphates will pass through a No. 100 sieve, containing 10,000 holes per square inch. It is now possible to obtain these mineral phosphates, with a guarantee that 80 per cent. will pass through a No. 120 sieve, containing 14,400 holes per square inch.

Trials at Cockle Park, 1922.—An important trial of phosphatic manures on poor grass land was commenced at Cockle Park in the North Field, Paradise, in February, 1922. Alongside the other dressings North African phosphates were applied to two plots at the rate of 6 cwt. per acre. This contained 63 per cent. of phosphates. In one case the fineness of grinding was 79 per cent. through a No. 100 sieve, and in the other 83 per cent. through a No. 120 sieve. The results already indicate that the more finely ground phosphate has developed clover and pasture plants more effectively than the other, and also that, so far, the results of this finely ground phosphate are quite comparable with that of high-grade basic slag.

The following table shows the approximate costs of high-grade basic slag and of finely ground North African phosphate, as offered to farmers in the north of England in September last:—

	Phosphates.	*Price per ton.*	* *Price per unit.*	*Nineteen units per acre in* †	*Cost per acre.*
	per cent.	s. d.	s. d.	*cwt.*	s. d.
Basic slag	38	91 0	2 4¾	10	45 6
Ground North African phosphate	60	80 0	1 4	6⅓	25 4

* Carriage paid to farmers' stations.
† Containing nearly 200 lb. phosphoric acid.

The basic slag is guaranteed that 80 per cent. will pass through a No. 100 sieve, containing 10,000 holes to the square inch; and the North African phosphate that 80 per cent. will pass through a No. 120 sieve containing 14,400 holes to the square inch.

[In an early issue of the *Journal* it is proposed to publish an article on Naura phosphate.]

* * * * *

THE PLANNING AND CONSTRUCTION OF FARM BUILDINGS:

A MODERN HOMESTEAD.

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THE planning and construction of a completely modern homestead is at the present time by no means an easy problem, and the publication of the plans for the new farm buildings at Seale-Hayne Agricultural College may be of interest, particularly as the scheme presents at least one departure from the accepted normal type.

The Traditional Type.—Since the middle of the last century, although variations may be found in detail in different parts of the country, the planning of the buildings of the larger farms in England has followed a more or less definite type.

The generally accepted principle has been to place what may be termed the administrative building, consisting of the accommodation for food storage and preparation and the accompanying necessary machinery, in a two-storied building on the north side of the steading, with the buildings containing stock arranged at right angles projecting southwards in two or more arms. The spaces between these ranges or wings are used as covered or open stock yards in which the main bulk of the farmyard manure is produced and kept until ready for distribution. Frequently, on the larger and more extensive holdings, this arrangement is duplicated.

Broadly speaking, where completely new buildings have been erected, the main objects have been to facilitate the economical distribution of prepared food stuffs and to provide shelter and accommodation for animals in the most concentrated manner. In many cases the buildings have been elaborate and costly in construction, conveying the idea that the then methods of farming were fixed for all time and that "adaptability" was a word undreamed of.

Present Day Conditions.—Before describing the accompanying plans it may be wise to analyse briefly a few of the more pressing problems of the moment, pertaining to farm design and construction, as applied to larger holdings.

Leaving the specialist out of account, it is probably correct to say that for general farming purposes the primary need is sound and economic planning designed in every possible way to limit capital expenditure, to cheapen production by ease and economy of labour and economy in annual maintenance, while in addition to these there is an ever-growing demand to find the best possible solution for the hygienic well-being and improvement of stock of all kinds and at the same time to increase production.

Another important factor is the demand for the production of clean milk, which in turn compels action of a more or less restrictive character to achieve the end in view.

In addition to these facts, there is the almost daily increasing importance of scientific research applied to every branch of husbandry, and it is therefore evident that the whole business of farming is passing through an exceptional period of transition. If these facts are admitted, it is all-important for the farm architect to keep an open mind, to watch for any signs of new ideas and methods designed to meet the problems of the moment, or to forestall the advent of those to come in the near future.

It is seriously suggested that the proper planning of farm buildings offers to the designer at least as many problems in arrangement and construction, albeit the latter may be of simple type, as any other scientific or commercial undertaking, but with one very important addition.

In most building undertakings of a commercial character there are two chief factors: (1) The efficiency, health and comfort of the human beings employed in the business, and (2) the convenience and efficiency of the building for its immediate purpose. In the planning of farm buildings we have

in addition the very vital problem of the health and well-being of various kinds of animals living under artificial conditions.

Our method of research into this latter problem is almost entirely empirical, and the best results are only attained by the somewhat crude method of trial and error and by examining into the causes of repeated failure or success.

It is true that a science of animal hygiene is being gradually built up, but in actual practice it is frequently found that the most elaborately planned and constructed buildings, where every care has been taken to give effect to current ideas, have failed to give the best results hoped for, while some simple and elementary arrangement answers all purposes.

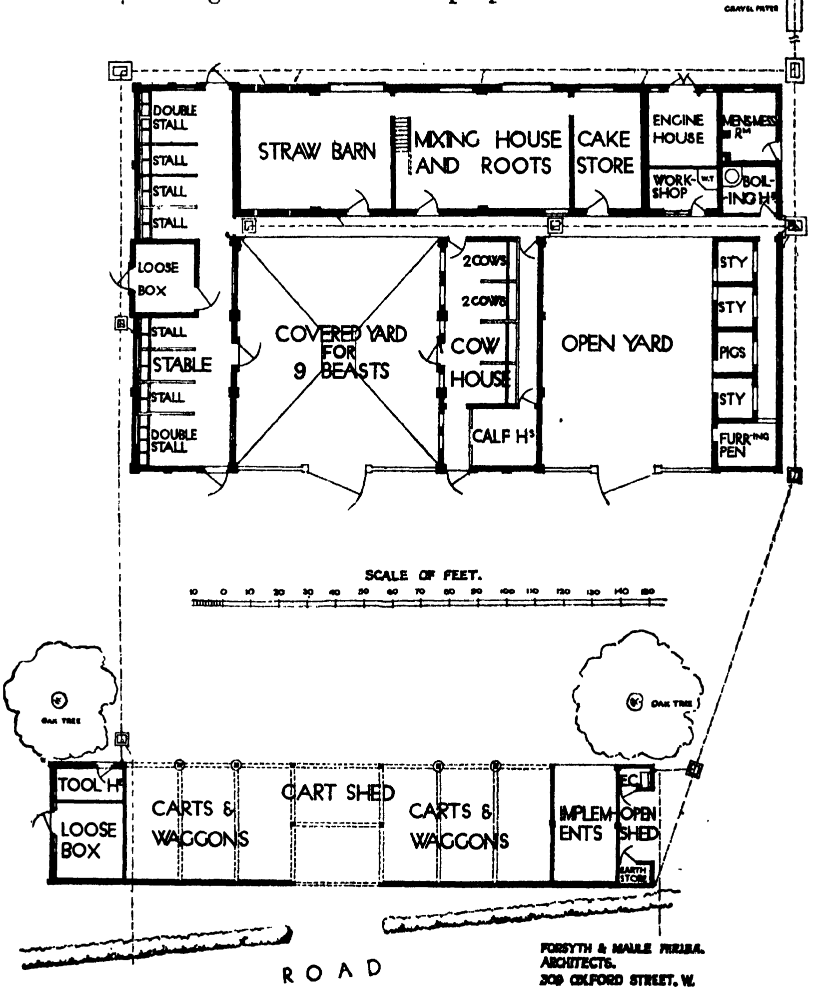

FIG. 1.—Plan of Farm Buildings, Newtown Farm, Lymington.

With the economic stringency of the present time and the necessity for an improved return on capital, it is obvious that the line of attack must be one which embraces cheap construction and at the same time allows of adaptability for future needs and improvements.

As has been said before in these articles any departure from accepted principles should be watched with interest, and, if found successful in practice, will form the basis for future development.

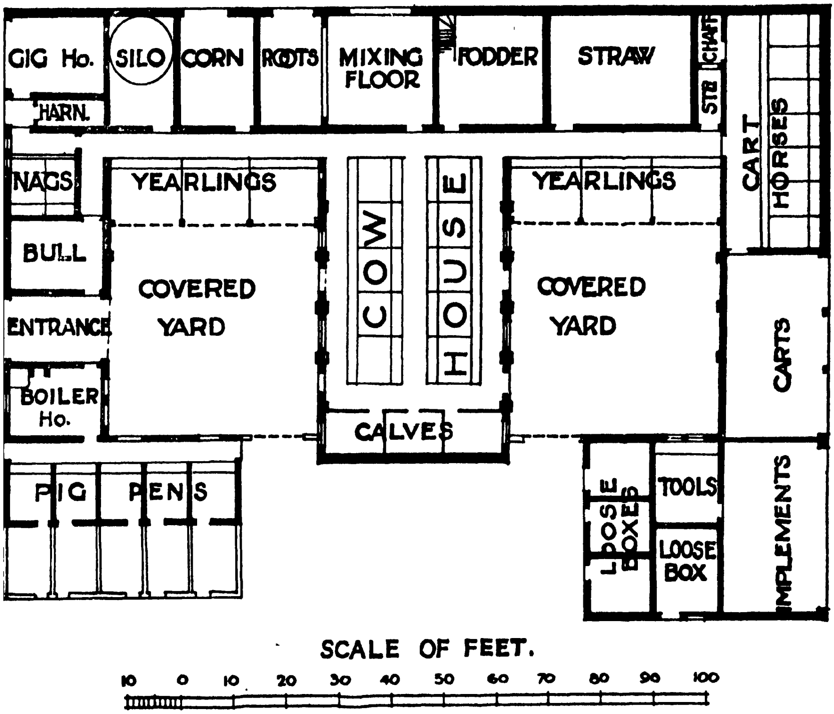

FIG. 2.—Original plan of Farm Buildings, Seale-Hayne Agricultural College.

A Traditional Plan, 1903.—The first plan (Fig. 1), given for the purpose of illustrating the traditional type referred to above, is that of a farm steading in Hampshire designed and built in 1903. The farm contained about 300 acres, mostly arable, and accommodation was required for a very limited number of cows, provision being made for eight. The cow house formed the centre range with a covered yard on one side and an open yard on the other, but access for the cows was provided without necessitating the crossing of either yard. The distribution of fodder to each wing is simply and directly

arranged for from the administrative block, and some care was taken for the comfort of the farm workers by the provision of a mess room. The plan may be said to be compact and straightforward, but the position of the cow house between two stock yards should no longer be considered ideal.

A Traditional Plan, 1914.—The second illustration (Fig. 2) shows the original plan for new farm buildings prepared for the Governors of Seale-Hayne Agricultural College, Newton Abbot, and is interesting as showing a distinct adherence to traditional type—in fact it is to all intents and purposes as true to accepted principle as is the earlier plan of Newtown farm shown in Fig. 1. Originally prepared before the War, nothing was actually done with regard to building until 1920, when the state of the existing farmstead at the Seale-Hayne College made a reconstruction imperative.

A review of the then situation, however, made it clear that the proposed plan, though excellent in itself, maintained the traditional position for the cow shed with its obvious disadvantages from the modern hygienic standpoint. Further, the plan did not lend itself well to future extensions or modifications in farming practice and was considered hardly sufficiently adaptable for modern scientific and experimental farming.

A New Type.—The third illustration shows the general layout plan of the new buildings as finally approved by the Governors and passed by the Ministry of Agriculture. It should be mentioned that the site is an exceptionally difficult one owing to the uneven nature of the ground, the character of the approaches, and the position of existing buildings, such as the dairy and College workshop already erected in 1914.

In view of future legislation with regard to the production of clean milk, and the intention of the Governors to keep a herd of dairy cows, the authorities at the Ministry of Health were consulted with regard to the placing and arrangement of the cow-house. The suggestion of the Ministry of Agriculture that the traditional position of the cow-house should be changed so that it no longer abutted upon stock and manure yards was welcomed, as it has long been proved that the main source of milk contamination is from minute particles of manure, from which it follows that proximity to a manure yard or pit must of necessity increase the risk of contamination. It is noteworthy that this departure from the normal and accepted type was decided upon on its own merits and was not due in any way to the falling ground or any peculiarity of site.

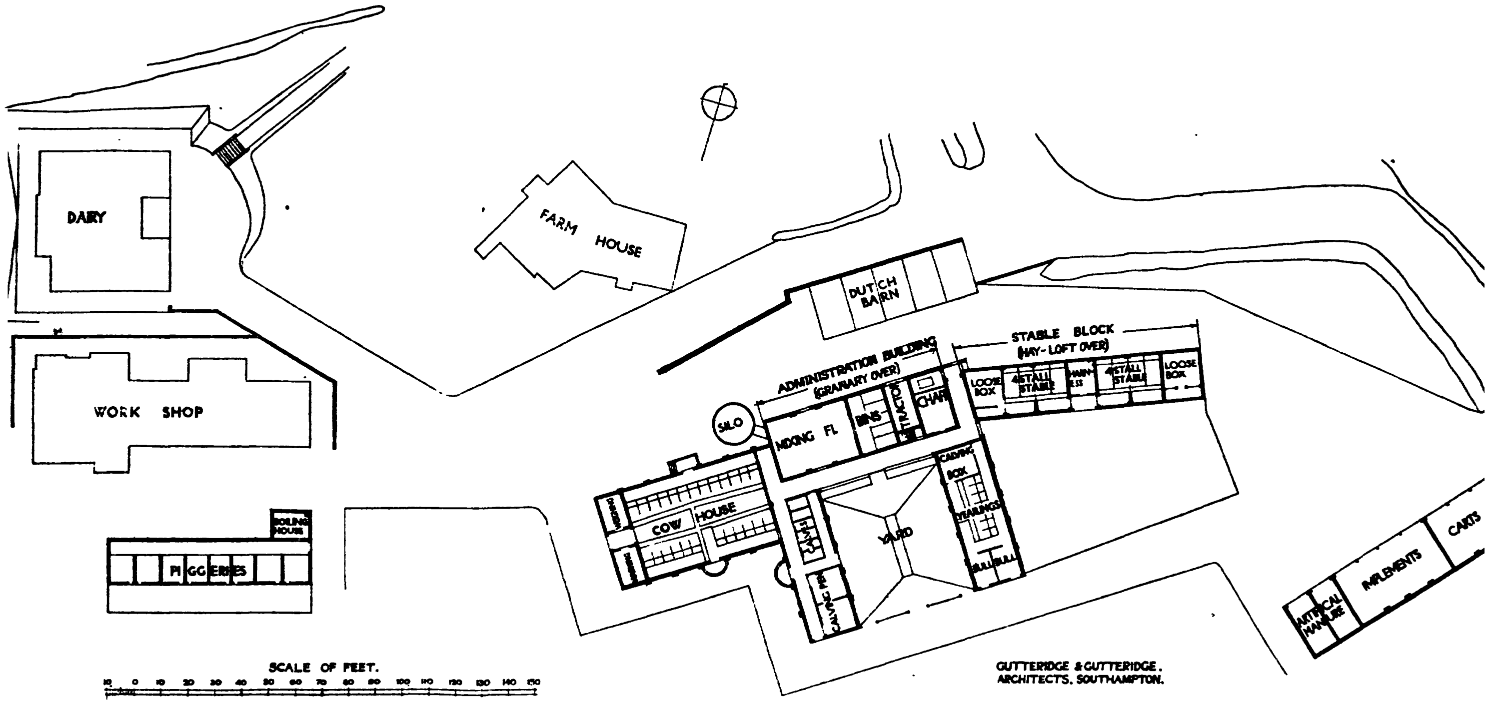

FIG. 3.—Plan of Farm Buildings as finally adopted, at Seale-Hayne Agricultural College.

A reference to the plan (Fig. 3) shows that the main administrative range occupies a normal position to the north, with Dutch barn and silo adjacent, but the cow house is placed to the west, though still in immediate proximity to the mixing floor and silo. Space has been provided for milk weighing and recording and for the men's lavatory. The cows enter off a hard road on the south side and milk is taken out to the dairy by a separate exit at the west end. The chief merit of this arrangement is that the cow-house is no longer in an enclosed position but is, as far as possible, isolated from the remainder of the buildings, open to sun and air on three sides, and free from the dust and flies inseparable from stock yards. The disposal of manure from the cow-shed will be by a gravitation trolley to a covered manure pit or into the stock yard.

The two southward projecting blocks are normally placed with a yard between, which it is intended to cover in when funds are available.

The position of the stables stretching eastwards from the administrative block and the position of the cart and implement shed were largely dictated by the nature of the site and the importance of obtaining an easy graded access.

Another point worth noting is the isolated position of the pigsties, to which whey will be gravitated from the dairy on the higher ground above.

The most careful consideration has been given to the practical arrangements for storing, preparing, and distributing fodder, and a reference to the plan will show that the departure from type, while it has distributed the buildings in a less confined form, has not materially increased the difficulties of food distribution.

It is not intended in this article to do more than draw attention to the general principles involved in the planning of these farm buildings, particularly with regard to any departure from the normal type, but it is urged that in this scheme the College authorities and their architect have introduced an important new principle in the relative position of the cow-shed to other buildings whereby the hygienic conditions requisite to assist in the production of clean milk must be materially better than could be the case were the traditional lines followed. It is also claimed that, so far as administration is concerned, both in feeding and cleaning, there is no loss but rather gain in efficiency and economy.

So far as the construction is concerned a permanent type was decided upon for various reasons, but it is suggested that this scheme lends itself to the method adopted by the Directors of the National Institute for Research in Dairying—*i.e.*, the administrative block, cow-house, and stables might be constructed in permanent materials, and the covered yard and south ranges might be built of timber with a light truss roof construction and cheap covering material. Such a method would admit of easy and cheap extension to the east when the conditions of farming required increased room for stock.

There can be little doubt that, at the present time when initial cost in construction is high and farming conditions are in a state of transition, adaptability is a very important factor, and there is therefore much to be said for building in such a manner that alteration and extension may be easy and cheap.

In conclusion, the writer would like to express his thanks to Mr. R. F. Gutteridge, of Messrs. Gutteridge, of Southampton, architects to the Governors of Seale-Hayne College, for his kindness in permitting the publication of his plans and for his cordial co-operation in all negotiations concerning them.

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POSSIBILITIES OF FRUIT AND VEGETABLE GROWING IN DURHAM AND CHESHIRE.

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THERE are some things which philosophy seems unable to account for. One is markets—why did they establish themselves just where they are? Why do many of them persist in spite of everything? Better alternative sites for Covent Garden Market have been suggested : some attempts have even been made to establish rivals : none, however, has dethroned it. With all its inconveniences and its incongruities Covent Garden Market still remains a magnet, attracting produce to its congested space from all parts of the world, and it continues to derange and obstruct traffic in the heart of our metropolis.

Another problem is the areas of the country where market gardening thrives. Why on just this spot or that spot has a colony of intensive cultivators become established? Why just here or there have men solved the smallholding problem for themselves, and are thriving on holdings of smaller area than one would like to pronounce as possible? Superficially some reasons

leap to view. Proximity to some great market; some topographical peculiarity of site giving advantages of climate; some particular geological formation of soil; some tradition of cultivation handed on from generations back. It is when individual cases are examined below these surface reasons that one is puzzled. Other markets as great, or greater, have not attracted similar colonies. Equal advantages of site can be pointed out where no exploitation exists—soils of attractive suitability are calling in many places for intensive cultivators but without response—traditions of cultivation are kept alive in a few, whose number does not increase.

Such reflections as these came home with great force when the writer was recently visiting the County of Durham in connection with the new Horticultural Station at Houghall, and the County of Cheshire for a Conference at Reaseheath.

At Houghall sixteen acres are being developed for demonstrating methods of culture and varieties of fruit and vegetables. Very little cultivation of this nature is done in the county, and an industrial population must draw its supplies of fruit and vegetables burdened with transport charges either from overseas or from other parts of the Kingdom—in either case losing the valuable quality of freshness. It may be said that the climate is atrocious or the soil unsuitable, but visits to some of the few growers in the county, and inspections of some of the allotments by no means support such a theory. In a village within twenty miles of a city in the county of Durham there is a grower who, on three-and-a-half acres is practising the most intensive culture with complete success, producing flowers, vegetables and fruit in profusion. He manages to get forced rhubarb, annuals, and bedding geraniums, tomatoes and grapes, from the same greenhouse in the same year. His Victorias, Czar, and Rivers Prolific plums were breaking down with fruit. He had heavy crops of Doyenne d'Eté and Fertility pears, as well as Grenadier, Lord Grosvenor and Bramley's Seedling apples. There was nothing that one could see exceptional either in site or soil. At another village in the same county there was a county council smallholding where a plot of fruit—apples, pears, and plums, with bush fruit and strawberries—had been planted under the advice of the horticultural instructor, and these were all healthy and thriving. One asks the question "Why has not the splendid market afforded by the large population in this area attracted more growers to benefit by it, and in so doing benefit the people therein as well?" It is to be hoped that Houghall will not only

suggest improved methods and better types to the existing growers, but will lead others to seize the opportunity which is afforded them.

In Cheshire the surprises in store were of a different character. Here, the county that in imagination had been pictured as stocked with mottled herds and redolent with cheese making, turned out to be carrying on extensive industries in intensive cultivation of fruit, vegetables and flowers. How many know that on the borders of Cheshire, overflowing into the neighbouring Welsh county of Flint, there is a firm of growers who cultivate 800 acres of strawberries; whose undertaking extends to 1,200 acres, and is devoted to three crops, namely, potatoes, spring cabbages, and strawberries—an establishment revealing a standard of cultivation, and an organisation that can challenge comparison anywhere.

In another part of the county there is gathered a colony of intensive cultivators whose holdings are admirable examples of "How to make the most use of the land," where clean cultivation, sustained fertility, and ingenious close cropping can be seen as well as anywhere in the world. In another district one finds that the soil, which is specially adapted to the growing of pears, has long been discovered by the local growers, although most of the sorts grown are of many old varieties, and the possibilities of development still await exploiting. The enterprise of a fruit merchant in planting out some 60 acres of top and bottom fruit of all kinds should, if as successful as it promises to be, give a stimulus to further development. In another area where some seaside marshes have been reclaimed by draining and hedging and years of intensive cultivation, there is a source of supply of vegetables which must be of great value to the population of Birkenhead and Liverpool, and one is surprised to know that the cultivators are nervous of the possibility of their being displaced by building operations.

In the midst of such a county, with so many alert and enterprising growers, and so many potentialities waiting for exploitation, the Horticultural Department of Reaseheath Agricultural Institute should have an important sphere of influence. There are still new methods that could be demonstrated. There are yet types of vegetables and fruit apparently unknown to the local growers, and especially there is a wide field of opportunity for demonstrating methods for combating diseases and pests.

The opening of two such demonstration stations is an event of great importance, and one can only hope that other counties in England will be able to follow along the same road.

THE POTATO FLOUR INDUSTRY IN HOLLAND.

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THE potato flour industry in Holland developed during the second half of the 19th century on the "fen-colonies" in the northern provinces of Holland—Groningen, Drenthe, Overysel and Friesland—where circumstances were specially favourable to the extension of this industry. These districts formerly consisted of vast stretches of moorland sparsely inhabited, and covered with layers of peat many feet deep. Even in the 17th century some of these peat bogs were under cultivation, and since that time hundreds of canals have been dug, affording excellent means of transport by water. By the application of nitrogenous and potash manures the soil has been rendered specially suitable for the cultivation of potatoes, while fairly efficient and inexpensive labour has been available among the peat workers of the district. The development of the industry appears, in fact, to have been due to the combination of suitable soil, good canals, cheap fuel and labour, and the increasing demand for potato flour for different purposes.

In 1840 the first potato flour factory was established in this part of the country, and since then many more factories have been built. After 1890 frequent disputes between the growers and manufacturers about the price paid for the potatoes led to the foundation of several factories on a co-operative basis, and at the present time most factories work on a co-operative basis.

The members of these co-operative factories undertake to deliver quantities of potatoes proportionate to the number of shares they possess, and they are responsible for the debts of the society in the same proportion. At the end of the financial year every shareholder participates in the profit on the sale of flour.

The capital necessary for building a large modern mill, producing about 10,000 tons of flour, amounts to 1,200,000 Dutch guilders (about £100,000), while in addition a working capital of about £60,000 is required. At the present time there are over thirty potato flour mills in the Netherlands. The co-operative mills originally formed the "*Growers' Association of Flour-mills,*" whilst the others formed the "*Association of Private Flour Manufacturers.*" These associations were founded to

meet the need of the manufacturers for information and mutual help, and had no concern with sales. The establishment in 1919 of the *Co-operative Sales' Office for Potato Flour* has, however, changed the system of selling direct from the factory. The task of this organisation is to sell the flour of its members in the most economical and profitable way, and to assist the manufacturers to solve problems concerning the improvement of methods of production, the increase of the output, and so forth. It is the opinion of the interested growers that on the whole the united co-operative factories now have a far greater influence on market prices than formerly, and this is mostly due to the activity of the Co-operative Sales' Office. The development of this office made the Growers' Association of Flourmills superfluous and it has recently ceased to exist.

While most Dutch industries are suffering greatly from the influence of the world crisis and the general trade depression, the co-operative potato flour factories have on the whole no reason to complain. Of late years the quantity of potatoes used for flour-making has been large, especially in 1919-20 and 1920-21, and flour prices are said to have been remunerative. The co-operative factories especially have profited by these favourable circumstances, because while the other factories have not always been able to obtain the necessary raw material, the co-operative factories, owing to the supply guaranteed by their members, have not met with this difficulty.

Of late years almost 70,000 acres of potatoes have been planted in the fen-colonies, where the average yield per acre amounts to 8, 9 or 10 tons. Only a small part is used for direct human consumption or cattle-food, the bulk being used for flour-making unless a bad harvest or any other crisis in the neighbourhood abnormally increases the demand for direct consumption.

All the Dutch factories together can use about 90,000 tons of potatoes a week, but the factories only work at their topmost capacity during harvest time and in the months of October, November and December. There are, however, a few factories that start in September and finish in January. During the remaining months of the year the material undergoes further manipulation, and in this way various qualities of flour are manufactured.

The quantity of potatoes delivered to the flour factories naturally varies with the harvest, and as mentioned above the co-operative factories have now absorbed the bulk of the trade. Figures for three years before and since the War are given below.

	Co-op. Mills. tons.	Other Mills. tons.	Total. tons.
1910/11 ...	244,000 ...	305,000 ...	549,000
1911/12 ...	228,750 ...	137,250 ...	366,000
1912/13 ...	405,650 ...	426,085 ...	831,735
1919/20 ...	523,075 ...	78,385 ...	601,460
1920/21 ...	508,740 ...	55,815 ...	564,555
1921/22 ...	329,0[illegible]5 ...	14,333 ...	34[illegible],430

The average production of flour is estimated at 380 lb. per ton of potatoes delivered at the flour mill. In normal years about 25,000 tons of flour are used in the Netherlands, the balance being exported.

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A SAFE METHOD OF PREVENTING "BUNT" IN WHEAT.

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THERE is perhaps none of the common fungus diseases of farm crops that more urgently needs attention at the present time than "Bunt," or "Stinking Smut," of Wheat.* In the years since the War, complaints of its increasing prevalence have been made from all parts of England. Professor R. H. Biffen, referring more especially to the wheat lands in the Eastern Counties, has written: †"Bunted wheat is far commoner than it should be. In part this is due to the fact that a good deal of the grain sold for seed purposes is infected. Buyers should be more on their guard, and if a single 'bunted' grain can be detected in a seed sample, that should be a sufficient reason for rejecting it. The reason for this apparently drastic course is that many vendors are too prone to assume that wheat can be adequately cleaned by the simple process of blowing out such grains. But whilst it is true that the *spore*-filled grains (bunt) can be removed in this manner, no wind current will dispose of the myriads of spores which inevitably find their way into the grooves of the grains or the brushes of hairs at their tips during the threshing of the crop."

Losses.—In a recent number of this *Journal*‡ outbreaks of bunt were recorded in Herefordshire, Shropshire, Cambridge-

* An illustrated Leaflet (No. 92) on Bunt, giving the full life-history, can be obtained post-free on application to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W. 1.

† *Jour. Roy. Agric. Soc. of England*, 81, p. 244 (1920).

‡ Vol. XXVIII, 1921, p. 730.

shire, Lancashire, Gloucestershire and Lincolnshire where from 25 to 55 per cent. of the ears were attacked. The following case is also recorded:—in a northern county a chance sheaf of wheat was taken from the binder and the ears counted: 525 were found affected with bunt and 563 free, *i.e.*, 48 per cent. of the wheat was infected! In Kent—East Kent, Mid-Kent and the Weald—bunt is far too prevalent, and serious infestations have occurred in crops of the varieties Standard Red, Yeoman and Marshal Foch. In one case a farmer growing Marshal Foch for a firm of seedsmen, had the crop thrown on his hands on account of the prevalence of bunt.

Whilst the worst infected fields are doubtless due to the farmer saving seed from a bunt-infested crop, the disease is present also in seed-wheat sold by seedsmen. In 1921, in a field of wheat (Standard Red) grown on Wye College Farm from seed supplied by a firm of seedsmen in the south of England, a counting of a sample of 1,000 ears in the field showed 5.1 per cent. of bunted ears—a serious infestation.

Pickling of Seed.—In 1921, in this *Journal*,* the writers pointed out: (1) that the common method of "pickling" wheat with a solution of "bluestone" (copper sulphate) was too dangerous, experiments showing that a solution of bluestone sufficiently strong to kill the spores of bunt present on the seed-wheat causes serious injury to the germination of the wheat; and (2) that a certain method of using a solution of formalin kills the bunt *spores* without appreciably affecting the germination of the seed-wheat.

Further field experiments have been carried out in 1921 and 1922, and their results, described below, show very clearly that by the use of a very dilute solution of formalin a simple, safe and cheap method exists for the prevention of bunt.

In our previous article cited above we wrote: "It is to be feared that many cases of a 'poor plant' in wheat may have been caused by the seed having been 'pickled' with too strong a solution of copper sulphate." Evidence we have collected since confirms this opinion. From inquiries we have made of farmers we have ascertained that it is often the case that a field sown with seed-wheat treated with a 10 per cent. solution of bluestone will show a poor and tardy germination, while where it has happened that a portion of the same field has been drilled with untreated seed-wheat of the same kind the germination has been good and quick. In one case a farmer (in East Kent) sent

* Vol. XXVII, 1921, p. 1013.

us some seed-wheat (Standard Red) which he had "pickled" in the traditional method with a 10 per cent. solution of copper sulphate (using 1 gal. to the 4 bushels). Comparing the germination of this seed with that of an untreated sample of the same seed, it was found that the "pickled" seed germinated only 47 per cent. in 10 days, increasing after 15 days to 57 per cent., and reaching finally 60 per cent.; the untreated seed germinated 98 per cent. in 4 days. In another case, where the same method was employed, again by a farmer, the treated seed (Marshal Foch) germinated only 70 per cent., while the untreated seed gave 100 per cent. germination.* Here, then, the farmers were killing from 30 to 40 per cent. of the seed-wheat before sowing it. Assuming that 2½ bushels of seed to the acre is the correct amount to be sown, there may thus be a sheer waste of ¾ to 1 bushel of seed-wheat to the acre. Sir Daniel Hall pointed out.† in 1920. that "if we could reduce the amount of seed used by one bushel an acre the country would gain 3 per cent. on its output of wheat, worth well over £1,000,000 a year at the present time.‡

I. **Experiments during 1920-21.**—The object of the experiments was to confirm previous results which showed that formalin was preferable to copper sulphate, and also to ascertain whether a more dilute solution of formalin than that previously used was equally effective.

The general method adopted was that described in the previous paper. Contaminated seed was obtained from the experimental plots of the preceding season and divided into 5 lots for treatment as shown in the table. Duplicate plots were sown (by hand) with each lot of seed, samples being retained and sent to the Official Seed Testing Station, where the percentage of germination was determined. As the plants grew the plots were examined periodically to see whether the treatment had had any adverse effect on the growth, but no difference in the general appearance of the plots could be seen. When the crops were harvested 1,000 ears were taken at random from each plot and examined individually for bunt. The results obtained were as follows:—

* We are indebted to Mr. S. T. Parkinson, Head of the Botanical Department, South-Eastern Agricultural College, Wye, for carrying out these germination tests.

† This *Journal*, Vol. XXVII, 1920, p. 626.

‡ As is, of course, well known, good crops are frequently obtained from seed "pickled" with bluestone. Until scientific investigations as to the correct rate of seeding have been made, it is open to any one to hold the view that a better crop is obtained by sowing the lesser quantity of viable seed caused by the bluestone treatment. The economic waste of seed would, of course, still remain.

TABLE I.

Treatment.	*Percentage Germination.*	*Number of Bunted Ears per 1,000.*	*Percentage of Bunted Ears.*
Formalin 1 : 320	98	(1) 6 (2) 4	0.5
Formalin 1 : 400	98	(1) 0 (2) 7	0.35
Formalin 1 : 480	99	(1) 4 (2) 10	0.7
Copper Sulphate 2.5 per cent.	99	(1) 46 (2) 62	5.4
Untreated	99	(1) 113 (2) 171	14.2

Discussion of Results, 1921.—In our previous article* we recorded the fact that formalin diluted 1 : 320 (1 pint to 40 gal. water) was as effective in controlling bunt as the 1 : 240 solution (1 pint to 30 gal. water) and was therefore to be preferred. The dilution 1 : 320 was the weakest used in all previous experiments; it was decided therefore to use in 1920-21, the weaker solutions 1 : 400 and 1 : 480, and contrast these with the solution previously used.

As will be seen from Table I all the formalin solutions gave satisfactory results, reducing the percentage of "bunted" ears from 14.2 to less than 1, the actual differences observed being perhaps within the experimental error. Since it was clear that the limit of dilution when formalin ceases to be effective had not been reached, it was decided to carry out a further series of experiments in the next year before publishing these results.

The one copper sulphate solution that was used, of 2.5 per cent. strength ($2\frac{1}{2}$ lb. to 10 gal. water), was the strongest that our previous experiments had shown could be used without seriously injuring the germination of the seed. As is shown in Table I, the control of bunt when using this copper sulphate solution was by no means satisfactory; the 5 per cent. of "bunted" ears that appeared in the plots would represent a very serious infestation in the field. In the writers' opinion the use of a copper sulphate solution, and also of the proprietary articles containing copper sulphate which are sold as remedies for bunt, should be abandoned in favour of formalin.

II. **Experiments during the season 1921-22.**—The object of these experiments was to test weaker solutions of formalin and also to obtain some information relative to the effect that the presence of whole bunted grains, in samples of seed-wheat treated by the formalin method, might have on the amount of bunt in the resulting crops.

* This *Journal*, Vol. XXVII, 1921, p. 1013.

In the first place it seemed desirable to ascertain whether whole bunted grains could be passed through a drill without being broken up. The following method of testing this was devised: 1,000 bunted grains were counted out and mixed with a gallon of seed free from bunt; this was passed through a drill* and collected. It was then steeped in water, when the bunted grains floated to the top and were collected and counted: 996 of the original 1,000 were collected in this way. A few of these were found burst in the water but this was probably due to water soaking in through slight cracks, as this was found to occur when slightly cracked bunted grains were put into water, but with these exceptions the grains were recovered whole. There appears then to be little danger of bunted grains becoming broken up in passing through a drill of the type used.

The field experiments for 1922 were modified from those of previous years in order to study the effect of deliberately sowing whole bunted grains with the seed.

About 1 pint of bunted grains had been collected from the plots of the previous season's experiment. 90 c.c. of these were measured out into each of 5 glasses; the rest were crushed up with a pestle and mortar and the powder (consisting of the spores of the bunt fungus) was sprinkled over about 1½ bushels of seed-wheat (Standard Red), the whole being mixed together until every grain, so far as could be seen when examining a handful of the seed, had a blackened tuft of hairs at the tip.

Ten separate gallons of this inoculated seed were then measured out, and to each of five of these were added 90 c.c. of the whole bunted grains, *i.e.*, approximately 2 per cent.

The samples were then treated as shown in the accompanying table. The formalin, applied as in previous experiments, was used at strengths varying from 1:320 to 1:800. The plots were sown on the second day after the treatment.

The plots were examined periodically but no difference in the stand could be detected among the plots. At harvest time 1,000 ears were collected from each plot and the number of bunted ears present ascertained.

Since, on the whole, the plots of which the seed contained unbroken bunt grains showed no more bunt than those of which

* The drill used was a Massey Harris No. 5 Disc Drill ("force feed"), set to sow 3 bushels to the acre, travelling at a speed of 2 miles per hour. The machine was operated, for the object of the experiment, by means of a crank turned by hand, so that the machine itself was stationary, thus enabling the passed seed to be collected in a sheet placed below the drill. We wish to thank Mr. C. Davies, Head of the Engineering Department, Wye College, for his assistance in this matter

the seed had none, it is to be assumed that the presence of such grains did not increase the amount of infection; the plots of which the seed received similar treatment are therefore taken together in calculating the percentage of bunt resulting from each treatment.

TABLE II.

Treatment.	*Whole Bunted Grains absent or present (2 per cent.) in the seed.*	*Percentage Germination.*	*Bunted Ears per 1,000.*	*Percentage of Bunted Ears.*
Formalin 1 : 320 ...	(1) Absent	98	0	0.05
	(2) Present	100	1	
Formalin 1 : 480 ...	(1) Absent	99	0	0.05
	(2) Present	99	1	
Formalin 1 : 640 ...	(1) Absent	100	7	0.65
	(2) Present	98	6	
Formalin 1 : 800 ...	(1) Absent	99	17	1.4
	(2) Present	100	11	
Untreated	(1) Absent	97	409	38.95
	(2) Present	100	370	

Discussion of Results, 1922.—The formalin solutions were used at the following dilutions: 1 pint of formalin to respectively 40. 60. 80 and 100 gal. of water. The results obtained, shown in Table II. showed clearly that the formalin became less efficacious the more it was diluted below the 1 : 480 (1 pint to 60 gal.) limit. The presence of 2 per cent. of whole " bunted " grains in the seed produced no increase of disease. The artificially contaminated seed produced in the two " control " plots as high a percentage of " bunted " ears as 37 and 40. In view of the intensity of the disease present its reduction to 1.4 per cent. in the plots where the formalin was used at the extreme dilution of 1 : 800 (1 pint to 100 gal.) is noteworthy, as indicating the efficacy of formalin as a fungicide against bunt. The results show that the use of formalin, diluted 1 : 480 (1 pint to 60 gal.) gives a perfectly satisfactory control of bunt. With formalin at this dilution no possible injury to the seed-wheat is to be feared, *provided that it is applied in the method described below.*

Summary.—1. The old traditional method of "pickling" wheat with a solution of " bluestone " (copper sulphate) should be abandoned. Experiments have shown that a solution of the strength necessary to kill the *spores* of bunt *seriously injures the germination of the seed-wheat.*

2. An easier, cheaper and a safe method of preventing bunt has been discovered in the use of a dilute solution of formalin, applied in the following manner:—

(*a*) The diluted solution recommended for use is prepared by adding one part of formalin* to 480 parts of water. (*e.g.* 1 pint formalin to 60 gal. of water, or for small quantities, 1 fluid oz. to 3 gal., or 1 tablespoonful to 1½ gal.).

(*b*) The diluted solution is slowly sprinkled over the seed wheat at the rate of 1 gal. of solution to 2 bushels of seed. The seed must be moved about and stirred until the grains are all thoroughly wetted, but in no circumstances must the solution be allowed to form pools under the heap in which grains might soak.

(*c*) The seed is then placed in a heap and covered with sacks which have been soaked in the formalin solution; the sacks should be uniformly wet but not dripping.

(*d*) The treated seed is left covered up *for 4 hours*, not longer†; then spread out to dry *in a thin layer* on a clean floor; if the floor has been previously used for untreated corn it should be wetted all over with the formalin solution and allowed to dry before the treated seed is spread on it.

(*e*) Precautions must be taken to prevent the re-infection of the treated seed, *e.g.*, sacks which have held untreated infected wheat must not be used for the treated seed unless they have undergone treatment by being soaked in the formalin solution or boiled in water.

(*f*) The treated seed when dry should be sown *as soon as possible.*

3. It would appear that a method involving the immersion of the seed-wheat and skimming off the "bunted" grain, or the use of machinery to secure the same end, is unnecessary.

* * * * * *

* Formalin is the trade name for a 40 per cent. solution of the gas formaldehyde in water. Purchasers should obtain a guarantee that the formalin sold is of the above strength, and see that it is a clear solution free from any precipitate. Formalin needs to be kept in a tightly closed bottle and only freshly prepared diluted solutions should be used, as the gas is volatile.

† In one case, that came to the writers' notice, of injury being caused, it transpired that the farmer had left the treated grain in a heap 18 in. deep from mid-afternoon till the following morning at 6.30.

THE FIRST YEAR'S WORKING OF THE SEEDS ACT, 1920.

The Seeds Act, 1920, and the Regulations made under it have now been in operation for twelve months and there is considerable evidence to show that farmers and others have already benefited. The main object of the Act is to protect the farmer against the danger of unknowingly purchasing and sowing inferior seeds. With this end in view, in the case of a sale of any of the principal farm or garden seeds the seller is required to declare in writing to the purchaser, at or before the time of sale or delivery, certain specified particulars as to the quality of the seeds, such as the percentage germination, percentage purity, presence of injurious weed seeds, etc Long before the disclosure of these essential particulars was made obligatory by Government action, all the well-known seed establishments made a practice of giving these guarantees, but the distribution of seeds in this country is carried on by a vast number of firms other than the large and better known seedsmen, and it is by bringing these smaller firms into line as regards guaranteeing the quality of the seeds they sell that the Seeds Act is doing good. It is also stimulating the demand for good seed, and so forcing off the market much of the low grade material. The value of seed is insignificant when compared with the cost of labour and of other materials, but the return from all expenditure on tillage depends largely on the quality of the seeds which are sown, hence the value of the Seeds Act in enabling the farmer or gardener to ascertain the quality of the seeds he is sowing.

Licensed Private Seed Testing Stations.—One of the greatest difficulties experienced in administering the Testing of Seeds Order, which was the forerunner of the Seeds Act, arose from the variation in results of tests carried out by different analysts. In order to overcome this difficulty, it was proposed, when the Seeds Act was being drafted, that there should be one central testing station for the whole of Great Britain and Ireland; and that all tests for the purposes of the Act should be carried out at this station. It was hoped that by concentrating at one station the most up-to-date apparatus, in the hands of a highly efficient staff employing the latest scientific methods, it would be possible to place seed testing on a sounder footing in this country than in any other part of the world. This proposal, however, did not find favour in Scotland and Ireland, both of

which countries wished to retain their own official stations. Nevertheless, the Seeds Act is so worded that the establishment of a central official station is still possible.

Once it had been decided to have an official seed testing station for each part of the United Kingdom, it was difficult to withstand the claims of those old established seed firms who had for many years tested their own seed in an efficient manner to be allowed to continue these operations. It was therefore agreed that tests for the purpose of the Act (except in the case of garden seeds) should be allowed at private testing stations, provided that they were licensed for that purpose by the Ministry.

Judging by the experience gained during the past twelve months, the system of having licensed stations is not likely to prove unsatisfactory. Variations in the results of tests occur from time to time, but their number and seriousness have been very considerably reduced.

Sixty-eight private stations in England and Wales have so far been licensed to test, as follows:—All kinds of seeds covered by the Act, 28; all kinds of seed except grass seed, 3; clover, ryegrass, cereal and field seeds only, 1; field and cereal seeds only, 5; field seeds only, 5; cereal seeds only, 26. Except in one case, the carrying out of tests for fees is not allowed in the case of these licensed premises, the privileges being limited to tests for the purpose of the purchase or sale of seeds in connection with the licensee's own business.

Among the conditions affecting these licences is one which requires a portion of every sample tested to be preserved with the necessary marks of identification for a period of three months. A selection of these reserved samples is taken from time to time by inspectors of the Ministry, for check tests at the Official Seed Testing Station. So far, however, remarkably few cases of serious discrepancy have occurred between the results obtained at a Licensed Station and the check tests carried out at the Official Station.

A number of analysts from these licensed stations, and others who hope to qualify for similar posts, have attended a special instructional course during the past summer at the Official Seed Testing Station, Cambridge.

Inspection of Seedsmen's Premises.—Visits to seedsmen's premises are carried out by the Ministry's outdoor staff. The total number of visits paid during the twelve months ended July, 1922, was 11,000, including nearly 5,000 establishments that had not been visited before in connection with the Seeds

Act. Practically the whole of the 5,000 not previously visited were firms where seeds are sold mainly in sealed packets only during a very short period in the spring, entirely as a side-line to the main business of the establishment. They included chemists, general stores, hardware merchants, provision merchants, confectioners, rural post-offices, ironmongers, coal merchants, stationers, fishmongers, fruiterers, barbers, boot dealers, dentists, newsagents, cattle dealers, butter merchants, cycle dealers, tea merchants, drapers and butchers.

It has been suggested that the Ministry's inspectors neglect to visit the small trader of the kind above referred to, but the figures given should disprove such a contention. It must be remembered also that it is much more difficult for the inspectors to discover shops which combine a small seed trade, limited to a few weeks in the year, with another business, than it is to find those establishments where the sale of seeds and kindred material is the principal business.

Control Samples.—The principal object in visiting premises on which seed is sold is to ascertain whether the provisions of the Seeds Act are being properly carried out. With this end in view it is necessary to draw a certain number of control samples for the purpose of having check tests carried out at the Official Seed Testing Station. During the season 1921-22 the number of control samples so taken amounted to 950, including 282 samples of clover, 177 of grasses, 9 of field seeds, 20 of cereals, 95 of roots, and 356 of vegetables. In addition, 280 control samples of sealed packets were taken and also 500 samples of seeds placed in reserve at the licensed private seed testing stations.

The check tests carried out at the Official Seed Testing Station showed that in 97 out of the 950 samples, the declaration as to germination, purity, etc., made by the seller was inaccurate to a marked degree in one or other of the particulars. These discrepancies were mainly in respect of clover, grasses and garden seeds; 12 per cent of the total number of clover samples; 15 per cent. of the grass samples, and 8 per cent. of the garden samples proving to be incorrectly described.

The principal source of error in the statements made by vendors was in respect of the percentage of germination. In 18 cases the declared germination differed from the results of the official check test by between 10 and 15 per cent. and in 25 cases the discrepancies were over 20 per cent. Ten cases showed a discrepancy of between 3 and 5 per cent. in the percentage

of purity and in 13 cases dodder was found in samples declared to be dodder free.

In addition to the above, 76 of the control samples taken were of seeds in connection with which no declaration whatever was being made. In the majority of these cases, however, the check test showed the seed to be of good average quality.

It is impossible to draw general conclusions from the results of the check tests on control samples as the figures are not strictly comparable with those of the previous season on account of the fresh ground broken by the inspectors. It is satisfactory to note, however, that in spite of the fact that a large number of "new" premises were visited, the number of control samples that it was considered desirable to take was considerably fewer than last season, and that the proportion of these control samples which were shown by the check test to be wrongly described by the vendors was only 2 per cent. in excess of last year's figure. Control samples are taken as a rule only in cases where the declaration of the vendor is suspected to be inaccurate.

In all cases where the check test showed a marked discrepancy from the vendor's particulars, the matter was taken up with the person concerned, and in practically every instance the action of the Ministry resulted either in the seeds being destroyed or returned to the firm from which they were purchased, or in the seller adopting the official test as the basis of his declaration in further sales.

Packeted Seed.—As already indicated, one of the most helpful features of the Seeds Act is the effect it is having in regulating the sale of seeds in small packets. It is well known that, in the past, large quantities of seeds, the age and germination of which left much to be desired, were sold in this manner.

Many small shopkeepers purchase a stock of packeted seed which is offered for sale during the sowing season year after year, until the supply is exhausted. As a result, much of this is of very poor germination by the time it comes to be sown by the unfortunate purchaser.

This practice is now prevented by the Seeds Regulations which require a statement to be delivered to the purchaser of packeted seed showing the percentage of germination and purity, the date of testing, and the season in which the seeds were packeted, etc. It cannot, of course, be claimed that the sale of poor quality seeds in packets has been stopped during the short period that these regulations have been in force, but there is evidence to show that an improvement has been effected, and

it is anticipated that the grading up process will continue, as more experience is gained.

During the 1921-22 season, the Ministry's inspectors discovered a large number of cases in which, owing to ignorance of the Regulations, the necessary particulars were not being declared by the seller. Steps have now been taken to visit the many comparatively small wholesale packeters who supply the packets to the small shopkeepers, for the purpose of explaining to them the provisions of the Regulations as affecting themselves, and as affecting the retailers to whom they sell their stocks of packets. The beneficial result of these visits is already apparent.

During the season 270 control samples of packeted seed were taken. The result of the check test on these samples showed that 83 per cent. were seeds germinating at or above the minimum prescribed in the Seeds Regulations; 10 per cent. germinated below the minimum but above two-thirds, and 7 per cent. were below two-thirds. The corresponding figures for the season 1920-21 were 81 per cent., 13 per cent., and 6 per cent. respectively.

(To be concluded.)

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REDEMPTION OF TITHE RENTCHARGE BY ANNUITY.

(1) **The Advantages of Redemption.**—It is generally agreed by both landowners and titheowners that the redemption of tithe rentcharge on reasonable terms is desirable. Redemption saves the landowner the trouble of verifying the accuracy of the demands sent to him half-yearly by the tithe collector and of having to remit the payments for sums which, in many instances, are very small. It also removes a possible cause of complication and delay in sales and other dispositions of land.

The chief advantages of redemption to the titheowner are that it saves him the cost of collection, which in some parishes is considerable, obviates a frequent cause of ill-feeling and litigation and extinguishes the tithe rentcharge for all purposes including the payment of rates and land tax, and thus relieves him of the necessity for taking steps from time to time to obtain a re-assessment of the tithe rentcharge for the purposes

of rating and taxation. It is not, however, always convenient to landowners to find capital sums for the redemption of tithe rentcharge on their lands, even though capital moneys are under the Settled Land Acts applicable for such purpose, and to meet such cases the Tithe Act, 1918, provided facilities for landowners to redeem by annuity.

(2) **Calculation of Redemption Annuities.**—By agreement between the landowner and the titheowner under the Act the consideration for redemption may be discharged by an annuity payable yearly or half-yearly for a period not exceeding 50 years. Section 4 (2) of the Act provides that the amount of the annuity shall be calculated in the following manner:—To interest not exceeding 5 per cent. per annum on the consideration money is to be added such sum as would be sufficient, if the periodical payments thereof were accumulated at compound interest at a rate not exceeding 4 per cent. per annum, to produce an amount equal to the consideration money at the end of the said period. The total of these two sums will give the amount of the yearly or half-yearly payment of the annuity as the case may be.

In any such case the Minister by order charges the land with the annuity, and the order contains provisions for giving effect to the charge and for protecting the interests of persons interested in the rentcharge.

(3) **Consents necessary to Redemption by Annuity.**—Under Section 4 (3) of the Tithe Act, 1918, however, no such agreement for redemption by annuity is valid:—

(*a*) If made by a spiritual person entitled in respect of his benefice or cure except with the consent of Queen Anne's Bounty; or

(*b*) If made by a person (not being a spiritual person so entitled) who is not empowered to sell the rentcharge unless he obtains the consent of some other person, except with the consent of that other person.

(4) **Redemption by Annuity of Clerical Tithe Rentcharge and Welsh Tithe Rentcharge.**—The Ministry understands that Queen Anne's Bounty will, as a rule, be prepared to consent under certain conditions to the redemption of any tithe rentcharge or tithe rentcharges amounting in all to not less than £1 payable by a landowner to an incumbent, and to advise the incumbent to agree to the same. The Ministry also understands that the Welsh Church Commissioners, who own over £200,000 tithe rentcharge in Wales and Monmouth, will, as a rule, be ready to agree to applications for redemption by annuity of any tithe rentcharge payable to the Commissioners.

(5) **Former Objections to Redemption by Annuity now removed.**—When the Tithe Act, 1918, was passed the following objections to redemption by annuity under that Act were urged:—

(1) There was no statutory power whereby redemption annuities could be apportioned except under the almost unworkable provisions of Sections 10 to 14 of the Inclosure Act, 1854, so that owners of land upon which redemption annuities were charged were in a position of considerable difficulty when they came to sell portions of the land.

(2) There was no statutory power under which the landowner could, if he thought fit, compel the redemption of a redemption annuity on fair terms.

(3) Where land was held in settlement, capital moneys belonging to the settled estate could not be applied in payment of the sinking fund portion of the annuity and consequently the tenant for life or other limited owner of the land who redeemed by annuity was liable, not only for the interest on the consideration money for redemption which might be said to take the place of the annual tithe rentcharge payment, but also for the sinking fund payment which was really capital outlay.

These objections have now been partially met by the Tithe Annuities Apportionment Act, 1921, and the position will be further improved when the Law of Property Act which has just been passed comes into force, *i.e.*, on the 1st January, 1925.

(6) **Apportionment of Redemption Annuities.**—Facilities for the apportionment of redemption annuities were provided by the Tithe Annuities Apportionment Act, 1921. Under Section 1 (1) of this Act an application for an order for such an apportionment can be made to the Ministry by any person interested in the land charged or any part of it without the concurrence of any other person. Section 1 (2) empowers the Ministry, on the application of an interested person, to require as a condition of making the order that any apportioned part of the annuity which does not exceed the yearly sum of £2 shall be redeemed forthwith.

(7) **Redemption of Redemption Annuities.**—When the Law of Property Act comes into force, *i.e.*, on the 1st January, 1925, any person interested in the whole or any part of the land affected by a redemption annuity will be empowered, without the consent of the annuitant or any other person, to free his land from the annuity by redemption under Section 92 of the Act, which amends Section 45 of the Conveyancing and Law of Property Act, 1881.

(8) **Settled Lands.**—Section 2 of the Act provides that Section 21 of the Settled Land Act, 1882, which sets out how

capital money arising under that Act may be applied, is to have effect as if the modes of such application of capital money included the discharge, purchase or redemption of any apportioned part of a tithe redemption annuity charged on the settled land or any part of it, or the discharge of such part as does not represent interest (*i.e.*, the sinking fund portion).

Section 64 (1) (iv) of the Law of Property Act provides in effect that in addition to the modes authorised by Section 21 of the Settled Land Act, 1882, capital money shall be deemed always to have been capable of being applied in the purchase or discharge of an annuity charged under Section 4 of the Tithe Act, 1918, on settled land or any part thereof or in the discharge of such part of any such annuity as does not represent interest.

It will be observed that these provisions of the recent Act supplement the provisions of Section 2 of the Tithe Annuities Apportionment Act, 1921, and authorise the application of capital money arising under the Settled Land Acts to unapportioned annuities. It is also to be noted that though the Law of Property Act does not come into operation until 1925, the provisions as regards the application of capital moneys of settled estates to the purchase or discharge of an annuity or to the discharge of the sinking fund portion of an annuity when they come into operation will be retrospective.

(9) **Preliminary Steps for Redemption by Annuity.**—It seems not improbable that the alterations in law above referred to may induce many persons interested in settled lands who have hitherto hesitated to redeem by annuity to consider whether they should not now take steps to avail themselves of the facilities now provided for that purpose.

Landowners who desire to redeem by annuity the tithe rentcharge owned by incumbents of benefices should, in the first instance, communicate with Queen Anne's Bounty, 3, Dean's Yard, Westminster, London, S.W.1.

In other cases it will usually be convenient for the landowner to make application for redemption to the Ministry in the usual form No. 157/L.T. in the first instance. He should at the same time send to this Office the usual search charge, which is 5s. if the property does not exceed 10 acres, 10s. if it exceeds 10 acres but does not exceed 30 acres, and a further 5s. for every additional 30 acres or part of 30 acres. For example, if the area included in the redemption is 300 acres.

this preliminary charge will be 10s. plus nine times 5s., *i.e.*, £2 15s. 0d. The amount thus paid will be credited to the applicant as part of the office fee, calculated in accordance with paragraph 19 of the Ministry's Instructions for Redemption, Form No. 261/L.T., which will eventually be payable by him before the order for redemption is made.

On receiving such an application the Ministry will, in the case of tithe rentcharge payable to the Welsh Church Commissioners, communicate with the Commissioners as regards the amount of the annuity, and subsequently notify the same to the applicant for his agreement. In cases where the tithe rentcharge is not owned either by an incumbent or by the Welsh Church Commissioners, the Ministry will itself suggest to the applicant for redemption what, in its opinion, would be a reasonable amount at which to fix the annuity and request him to communicate with the titheowner with a view to obtaining his agreement to the same, if possible.

(10) **Redemption by Lump Sum does not require Consents.**—Where redemption by a lump sum is proposed it is still possible for the landowner to redeem without the consent of the titheowner or any other person. In the absence of any agreement as to the amount of the consideration money, the Ministry determines the amount in accordance with the First Schedule to the Tithe Act, 1918, the provisions of which are explained in paragraph 4 of the Ministry's Instructions for Redemption No. 261/L.T.

(11) **Redemption where Land has been taken for Public Purposes.**—Under Section 1 of the Tithe Act, 1878, as amended by the Tithe Act, 1918, it is provided that where land charged with tithe rentcharge is taken for any of the following purposes, viz.:—

The building of any church, chapel, or other place of public worship;

The making of any cemetery or other place of burial;

The erection of any school under the Elementary Education Acts;

The erection of any town hall, court of assize, gaol, lunatic asylum, hospital, or any other building used for public purposes, or in the carrying out of any improvements under the Housing of the Working Classes Act, 1890;

The formation of any sewage farm under the provisions of the Sanitary Acts, or the construction of any sewers, or sewage works, or any gas or water works;

Or the enlarging or improving of the premises or buildings occupied or used for any of the above-mentioned purposes;

the person or persons proposing to carry out the above-mentioned works, buildings, or improvements, shall apply to the Ministry to order the redemption of the tithe rentcharge.

Representations have been made to the Ministry that the provisions of this Section are frequently disregarded by the landowners concerned. There may, perhaps, have been some justification for this before the passing of the Tithe Act, 1918, when the consideration money for redemption had to be calculated on the basis of 25 years' purchase of the par value of the tithe rentcharge. Now, however, that it is possible to redeem on equitable terms it is desirable that in all cases to which the Section applies application for redemption should be made forthwith.

(12) **Redemption of Corn Rents.**—The provisions relating to tithe rentcharge referred to in the foregoing paragraphs substantially apply also to corn rents, rentcharges, and money payments (other than rentcharges payable under the Extraordinary Tithe Redemption Act, 1886) which are liable to redemption under the Tithe Acts, 1836 to 1891.

(13) **Forms.**—The following forms will be supplied on request:—

(*a*) Instructions for the redemption of tithe rentcharge and corn rents, etc., in cases where the application is made by the landowner (Form No. 261/L.T.).

(*b*) Application for the redemption of tithe rentcharge in such cases (Form No. 157/L.T.).

(*c*) Application for the redemption of corn rents, etc., in such cases (Form No. 204/L.T.).

(*d*) Forms of continuation schedule for use in the redemption of tithe rentcharge or of corn rents, etc., in cases where the schedule provided in the form of application is not sufficient to show all the rentcharges proposed to be redeemed (Form No. 133/L.T.).

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THE MAKING OF CLOGS, CLOG-SOLES AND CLOG-BLOCKS.

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IN the year 1337 a number of Flemish clothiers and weavers settled in Bolton, Lancashire, and the weavers brought with them their sabots or wooden shoes. The sabots were made entirely of wood, with lamb-skin linings to protect the feet. Wooden

shoes are known to have been worn in London earlier than the 14th century, and may have been used in other parts of the country, but they were new to Lancashire.*

Clogs are wooden shoes with leather uppers, and pattens have rings of iron to keep the shoe off the ground. No kind of footgear could keep the feet warmer and dryer on wet ground, and they are reputed to protect the women who work in the Lancashire weaving sheds, which have damp floors, against rheumatism and other ills. Clogs are worn extensively in Lancashire, West Yorkshire, and in neighbouring counties, by men, women and children. They are useful for dairy-work, both on the farm and in the cheese-factory, and are admirable for gardening, poultry-keeping or other work that involves standing or walking in wet places. Fashion has done ill-service to workers and children by decreeing that boots, however poor in quality, are smarter to wear than clogs. Clogs have light grooved irons underneath the edge of the sole and heel to make them wear better. A piece of leather is sometimes nailed on the sole within the irons to deaden the clatter which is apt to provoke merriment in districts where they are unfamiliar. Compared with thick boots they are not unduly heavy. The uninitiated would suppose that a rigid wooden sole would be most uncomfortable; but the clogs are large enough for the foot to have freedom inside, and they depend upon the buckled flaps or laces that meet over the ankle to keep them on. There are several types, the "Lancashire" being distinct from the "country," and considered to be smarter wear owing to the slightly pointed toe, which would be most uncomfortable unless extra length were allowed. "Country" clog wearers desire no such decorative style. It has been said that the habitual wearing of clogs from childhood checks the development of certain muscles at the back of the leg, and that clog-wearers may be known by their rocking walk as though they had runners or rockers on their feet. Shoes or slippers, however, could be procured for summer and indoor wear and for running about at games, while clogs are greatly to be preferred to the cold and sodden boots that must often be worn by children who can have only one pair at a time.

Kind of Wood Used.—Alder wood is preferred to any other for making clog-soles. It is so scarce that gangs of clog-block cutters visit the districts where it grows, sending off the roughed-out pieces of alder to the northern counties where clog-soles are fashioned from the blocks. The scarcity of material is no new

* From "A Short Sketch of the Clog and Patten Trade," by Alderman Broughton, published by the Amalgamated Society of Master Cloggers.

difficulty. In the year 1456 the Clog and Patten Makers made a pitiful appeal to the King to be allowed to use such pieces of "tymber of Aspe" as would not serve to make arrows. Their petition appears to have been granted for the time being, but in view of a projected invasion from France, the restraint on the use of this timber was again enforced on the clog-makers.

The "Aspe" timber is a kind of poplar, extensively grown on the Scotch hills but seldom used by cloggers at the present day. Birch is sometimes used, but alder makes the most comfortable clogs and is less apt to split than beech which is also sometimes used. The hand-made alder soles are preferred in Lancashire to the beech soles made in factories. Machinery is of fairly recent introduction and improvements are expected which will cause the machine-made soles to compete more effectively with the hand-made. It is also rumoured that ready-made soles may be sent over from the virgin woods of North America. By this means greater economy in transport than the English clog-block cutter can secure will be effected through leaving the waste material behind. He goes to the woods to work, selling his waste as firewood if he can, and burning up the small chips in his own fire. The clog-block, though it is cut to definite sizes for children's, women's and men's clogs, still has to be reduced greatly by the clog-sole maker to whom it is sent. His yard becomes littered with growing piles of chips as he cuts away at the blocks. It is said that three-quarters of the blocks are cut to waste. This illustrates the truth that wood-industries should not be isolated, disconnected crafts, but that the waste or parts less suitable for one craft should be passed on to be used for some other purpose with as much economy as possible in time, material, skill and transport.

The interdependence of various wood-trades is also illustrated by the fact that alder and birch are used both for broom-heads and for clog-soles. A Devonshire wood-dealer whose principal trade is in firewood, sets turners to make broom-heads and clog-block makers to cut clog-blocks out of material sorted for each purpose.

Cutting the Blocks.—The birch and alder, chiefly alder, is bought where it can be obtained in fairly large quantities, either felled or standing in the woods. The price is a matter of arrangement with the owner of the woods, who will often give credit until the returns from the finished clog-blocks come in. This makes it easy for a workman to become a master, as capital is only required for paying labour and board. During the War,

when demand was keen and prices were high, many workmen established businesses for themselves. For the roughest work of felling and sawing labour is often hired on the spot, but for the actual clog-block cutting skilled workers are employed who travel in gangs of six or seven. The system is the same as that in the timber trade when gangs are sent out to fell trees. Before the War, a Shropshire timber-merchant and clog-block dealer employed some twenty-five to thirty clog-block cutters. They travelled from place to place in various parts of the country, Salisbury, Oxford, Thetford and Southampton being amongst the places mentioned by this Shropshire merchant. Thus it sometimes happens that a travelling clog-block cutter settles down in a district where alder flourishes and sends off his blocks to former employers or other acquaintances in the trade. Some of the clog-block dealers who are settled in the south and west of England may be known by their speech and enterprise as North-countrymen.

The tree or pole after being felled is sawn into fixed lengths of four sizes, for men, women, boys and children. If the wood is knotty there is more waste, and only the smaller sizes can be cut. These lengths are then placed on wooden block supports and cut into shape with a special tool. This is a knife made of one piece of steel about 2½ ft. in length, bent to an obtuse angle in the middle, the lower half forming a blade about four inches deep and terminating at the end in a strong hook. This secures the knife to a wooden block driven firmly into the ground. This block forms one of the two supports of a low bench on which the piece of alder is placed and the knife is worked as on a pivot. The cutter grips it with his right hand by a wooden handle at right angles to the steel, stooping, and cutting downwards with remarkable certainty and rapidity, while he holds and moves the clog-block with his left hand. The cuts are made at angles, and the block trimmed with an axe, so that it represents very roughly the final shape of the clog-sole. The blocks are then stacked to dry in bee-hive shaped heaps as high as a man can reach, built as peat-ruckles are built with air spaces between the blocks. When a truck-load of blocks is ready, it is sent off to Lancashire.

Not a Whole-time Trade.—An employer did not consider that pre-war earnings yielded a " living wage " but the men are paid by piece-rates and their earnings vary with their skill. The clog-block trade is not carried on by itself, for the masters, and probably the men too, require some other source of income.

For example, a Shropshire employer is a timber merchant and keeps a small inn, and an employer in Devonshire is a firewood dealer who also has a small wood-turning industry, making brush-stocks. The former sends gangs of cutters near and far; the latter, as yet in a small way of business, had employed a single cutter until others had learnt the art, and is only using wood obtained near at hand.

No evidence has been found in the three counties under investigation (Shropshire, Staffordshire and Cheshire) to show that the separate trades of the clog-soler who cuts the block to the final shape, and the clog-maker who makes and fixes on the uppers, are rural industries. The cloggers are often cobblers as well and they are to be found in the towns. They buy the soles and attach uppers which are frequently made from old boots.

Two very interesting cloggers were found in a country town in Shropshire, and their business proves that clogging still survives as a complete self contained craft. Of these two, one has sons in the trade and the other has not. Material is obtained in the neighbourhood, for present railway freights are prohibitive to a small-scale business. Even on local wood haulage costs have been high. One of the cloggers, who would like to get his supplies close at hand, estimates that £100 a year could be made from four and a-half acres of waste land near by if it were planted with alder. Some alder can be cleared by thinning every five years in such a way that other shoots grow strong, but the best material for clogs comes from wood of twenty-five to thirty years' growth. The clogger held out his hand, palm upward, with the thumb and fingers bent to show how five alder shoots should be left to grow out from the stock and then shoot up straight and strong. He does not care for older material as there is more sawing and cutting to be done to it, and consequently the costs are higher.

The son, who cuts the blocks and does a sawing and clearing business for fences and firewood, prefers to work in his own shed at home and not out in the woods. Therefore the problem of waste wood, on which haulage to the yard has been paid, is seriously exercising his mind He is thinking of toys and other small wooden articles. He does not use the usual block-cutter's knife when working at home, but shapes the blocks with his saw, which is worked by means of a small engine, after they have been cross-sawn and cleft to the right size. He is also considering a small portable saw which could be used out in the woods, and is interested in engines whose furnaces can utilise chips and saw-

dust as fuel. All their wood is cleft, the saw only being used for cross-sawing and trimming the cleft pieces to the correct shape for clog-blocks. Straightness of grain is important in this trade, and cleaving secures this.

Making the Soles.—The sole-making is done with a tool similar to that used for block-cutting. The craftsman seems to know by heart the exact curve that is needed for comfort, and with very little measurement is able to make the right shapes for every size in clogs. Some clog-makers get leather for the uppers from the mills; it is strong, thick and supple, and impregnated with oil, which makes it soft and weather-proof. The leather is in wide strips which have been used to cover rollers in the mills. Once it has worn a little thinner in one part than in another, it must be removed from the rollers, which must be exactly cylindrical; it can therefore be had cheaper than new leather and the thin parts can be cut away. A stretching machine is used to shape the leather so as to give the necessary spring for the instep. The uppers are made in two pieces only, a third piece inside giving strength to the heel. They are sewn together with a sewing machine, such as boot-repairers use, and when the upper is nailed to the sole, and the irons and fastenings are put on, the clog is complete. Some clogs are lined with felt.

The Outlook.—Cloggers are very scarce, as no boys have been learning the trade. There was an abnormal demand during the War, when no foreign clogs were coming in, and this appears to have stimulated the use of machinery. Demand fell off somewhat during the latter part of the War, when boots were worn owing to higher wages, and the trade appears to be feeling the general depression at the present time.

There is said to be an opening for small clog-making enterprises in the south of England, where clogs are not unknown, and might, it is thought, be popularised if light, comfortable types were put on the market and the retailers induced to stock the irons for replacement when worn out. This lengthens the life of the clogs and makes them all the more economical in comparison with boots. The irons and buckles can be procured from Lancashire and would probably not be worth making locally, but a small clogging firm would have to include a wood-dealer who would be responsible for felling the wood and preparing the clog-blocks, a skilled clog-sole maker, and a boot-maker or repairer who could make and fasten on the leather tops. Such a partnership would probably be the best means of working up a local

"bespoke" retail trade with customers who like their footgear made to measure. A man might have a good chance of working up a small local trade, but he could not increase it largely without meeting competition from machine-made and imported clogs. His success would depend on (1) real superiority; (2) economies effected by getting local alder made up locally, which would otherwise go north as clog-blocks and come south again as clogs; and (3) facilities for getting suitable leather on special terms. It is not thought that clog-sole machinery would be worth introducing into a small concern, and there is no reason to suppose that a big industry would pay.

The presence of clog-block cutters in alder-growing districts would be a helpful factor in launching small experiments, since the cutters or their employers are in touch with other branches of the industry. It would not be impossible to provide the essential safeguard for men undertaking a new venture; that is, to see that they have some alternative outlet in case of decline or failure in the trade. This could be done by connecting the industry with wood-dealing and other wood-crafts and perhaps also with boot-repairing. The small-scale craftsman can rarely afford to be a "one-job" man. Clog-solers are reputed to be scarce because during the War they were wanted out in the woods and did not care to settle down again to indoor work. Probably their real reason was the competition of machine-made clogs which drove them away from their former occupation.

There is a tendency for skilled journeymen to move away from areas where machinery is displacing their special craft, and to set up small businesses in some remote or rural district for a market in which competition from the machine-made product is not acutely felt. It may or may not be a local market, but it is a special market in which their specialised skill, or personal qualities, have value. It may, for instance, be a retail trade, in an article of distinctive quality, made under conditions in which the compensating advantages of personal skill and of any economies in getting the small lots of material near at hand, balance the advantages of big-scale production and wholesale distribution.

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FOOD IN RELATION TO EGG PRODUCTION.

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IN the economics of egg production, the relation that feeding costs bear to the total cost of production on one hand, and what relation the cost of food bears to the value of the output of the birds, always excite attention. It has become almost a truism to say that feeding costs taking the year through should not exceed the price of one egg per week, nevertheless it is difficult to find satisfactory data on which such an opinion can be based. The soundness of the opinion cannot be doubted, but it obviously opens up questions that must be explored in the immediate future, if the industry of commercial egg production is to be continued successfully. The suggested limit of feeding costs depends on two factors, the price of feeding stuffs and the price of eggs. Both factors are variable and liable to have their relationship materially altered by developments that are already making their influence felt.

We have two well-defined schools of thought. On the one hand we have those who by reducing production costs, feeding of course being part, look for an increased profit on a comparatively low egg-yield per bird, and we have those who are prepared to spend more on production and recoup themselves by a higher egg-yield.

So far, no detailed figures seem available showing the cost of production per thousand eggs, on a plant running successfully with a low average egg production. It follows that if the plant is successful on a low average, production costs must have been cut rather heavily to show a profit at all, and the feeding costs will have been cut with the others. In the absence, however, of records of the system we are bound to approach the question of feeding costs from the opposite angle, that is from the point of view of comparatively high feeding costs, on a high flock average.

In passing, however, it might be as well to point out that low feeding costs do not necessarily result in a low flock average. Our knowledge of food stuffs is incomplete, and it is by no means certain that through comparatively high priced grain and milling offals lies the only way to feed the necessary food elements to laying hens. In more than one case, individual breeders have availed themselves of unconventional food due to cheap local supplies, without damage either to the birds or their produce.

When we approach feeding costs in relation to egg production from the point of view of high flock average, we have the figures extending over three years of The Harper Adams College Laying Trials, which are summarised on the accompanying diagram. Before proceeding to deal with the costs in detail, it might be as well to answer one or two criticisms that have been urged against them.

In the first place it is claimed that the feeding cost per bird is unduly high. This is not denied, but the point of view from which these figures should be approached, must be that of poultry keepers and not the wholesale millers. The prices given month by month do not represent so much the actual price paid for the food, as the price at which small poultry keepers locally were buying the foods used during the same period. The difference between the two levels of prices when worked out to cost per bird, would only be a fraction of a farthing, but expressed as price per ton is a much more considerable item.

It has also been stated that the feeding costs are high because the foods used were unduly expensive and that cheaper substitutes could have been found. The main purpose of the Laying Trials, however, is to get the maximum output in a definite period, a very different problem to getting the maximum output on the minimum cost. To let any outside consideration affect the question of immediate output, would be foreign to the purpose of the trials. The birds have to demonstrate their ability as producers between 1st November and 3rd October of the following year, and in fairness to the breeder concerned no question of experiments with feeding ought to be considered.

The accompanying diagram gives the average feeding cost and the average output per bird during the last two years' trials and their relation can be seen at a glance.

This chart of comparative values is interesting as showing that there is a relation between feeding costs and the value of eggs produced. A sharp rise in both values is experienced from the beginning of November until early in January, after which there is a continuous drop until low values are reached in the early spring and summer, and the curves do not recover, until November again comes along.

But this must not be pushed too far. Although this factor has become a regular feature since these feeding costs were first compiled three years ago, it may be due to the nature of the trials. Although the value of food increased during this period, the actual weight consumed was normal. It is obvious that the rise

in egg values is due to scarcity during the winter, and in all probability the rise in food values for the corresponding period is due more to a personal, than an economic factor. The poultryman in charge of the trial was in all probability feeding heavily the more expensive foods, in order to get his output quickly up to its maximum, and just to what extent this personal factor comes in, it is impossible to say until the conclusions arrived at by the study of these figures can be checked by experimental work on a commercial basis. But it must be very obvious that if, while maintaining the high curve of egg values, the corresponding curve of food value could be flattened to its summer level a very material difference would be made in the profit. While a few pence per bird is not a great item taken by itself, it becomes so when spread over 740 birds, or as will be the case this year, nearly two thousand.

A study of comparative weights shows that while values are related weights are not. The heaviest feeding weight does not correspond with the greatest output.

But interesting as the study of comparative values and weights may be, there is a further aspect of feeding for egg production that should not be lost sight of. In the "Feathered World Year Book" for 1921 the writer called attention to the relation that exists between quality of food consumed and the actual output of eggs. There can be little question that quality of food is closely related to output, and it is interesting to notice from the accompanying diagram, that during the years when the quality of food was at its worst, the output of eggs per bird was also the lowest registered. The same thing holds true of the percentage of second grade eggs to first. The poorer the food became the more second grade eggs were recorded, as will be seen from the following table :—

Summary of Second Grade Eggs during four Winter Months.

	1915-16.	*1916-17*	*[illegible]-18.*	*1918-19.*	*1919-20.*	*1920-21.*
1st Grade	66·1	51·8	[illegible]1	72·92	77·3	75 69
2nd Grade	33·9	48·2	[illegible]5·9	27·08	22·7	24·31

There is one aspect of feeding costs in its relation to production that has not yet been dealt with. It is a mistake to assume that eggs alone represent the output of value from any given pen. In the growth of flesh and in the production of manure we have two items less by far in value than the eggs, but still considerable, to set off against the food and other costs. While flesh and manure are usually disregarded in working out values it is obvious they should be included. Even at the end of

a season of heavy laying, some of our dual purpose breeds will show an increase in carcass weight, and consequently a higher killing price would be obtained. Similarly the manure produced if properly stored and used is a most valuable commodity, and its value should certainly be credited to the pen performance. An ordinary pen, fed as the Harper Adams Laying Trial birds are fed, will produce a quarter of a ton of manure per annum showing the following approximate analysis:—water 72·6 per cent., nitrogen 1·42 per cent., phosphoric acid 2·01 per cent., potash 0·42 per cent. Expressed another way each pen of six hens competing at the trials, produces roughly between 7 and 8 lb. of nitrogen. 10 lb. of phosphoric acid and 2½ lb. of potash. When it is remembered that this year the birds may be expected to produce nearly one hundred tons of this highly concentrated manure, to disregard it in relation to feeding costs appears to be a mistake. The unsatisfactory state, in which the storage and use of poultry manure is at present, opens up another question outside the scope of this paper.

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A NEW APPLE PEST.

J. C. F. Fryer, M.A.,

Pathological Laboratory, Ministry of Agriculture, Harpenden.

A report has recently become current in horticultural circles of the appearance in England of a weevil allied to the Apple Blossom Weevil but even more destructive in its habits, and it may therefore be of interest to *Journal* readers to give a few details with regard to the discovery.

In the spring of 1921 Mr. F. R. Petherbridge, of Cambridge (Adviser to the East Anglian Province) found on the borders of Norfolk one or two weevil larvæ resembling those of the Apple Blossom Weevil, but feeding in the unexpanded leaf or truss buds of apple and not in the actual blossom buds themselves. As soon as one of these larvæ, after pupating, had turned into an adult weevil, it was evident that a species different from the Blossom Weevil had been obtained. In August of the same year Mr. Harwood, when collecting beetles in Kent, obtained under bark in company with Apple Blossom Weevils an example of the same kind of beetle as had previously been reared by Mr. Petherbridge. Both the Kent and Norfolk specimens have since been identified as a species of weevil (*Anthonomus cinctus*, Kollar, =*A. pyri*, Boh.) not previously recorded in Great Britain and therefore of course without any English name.

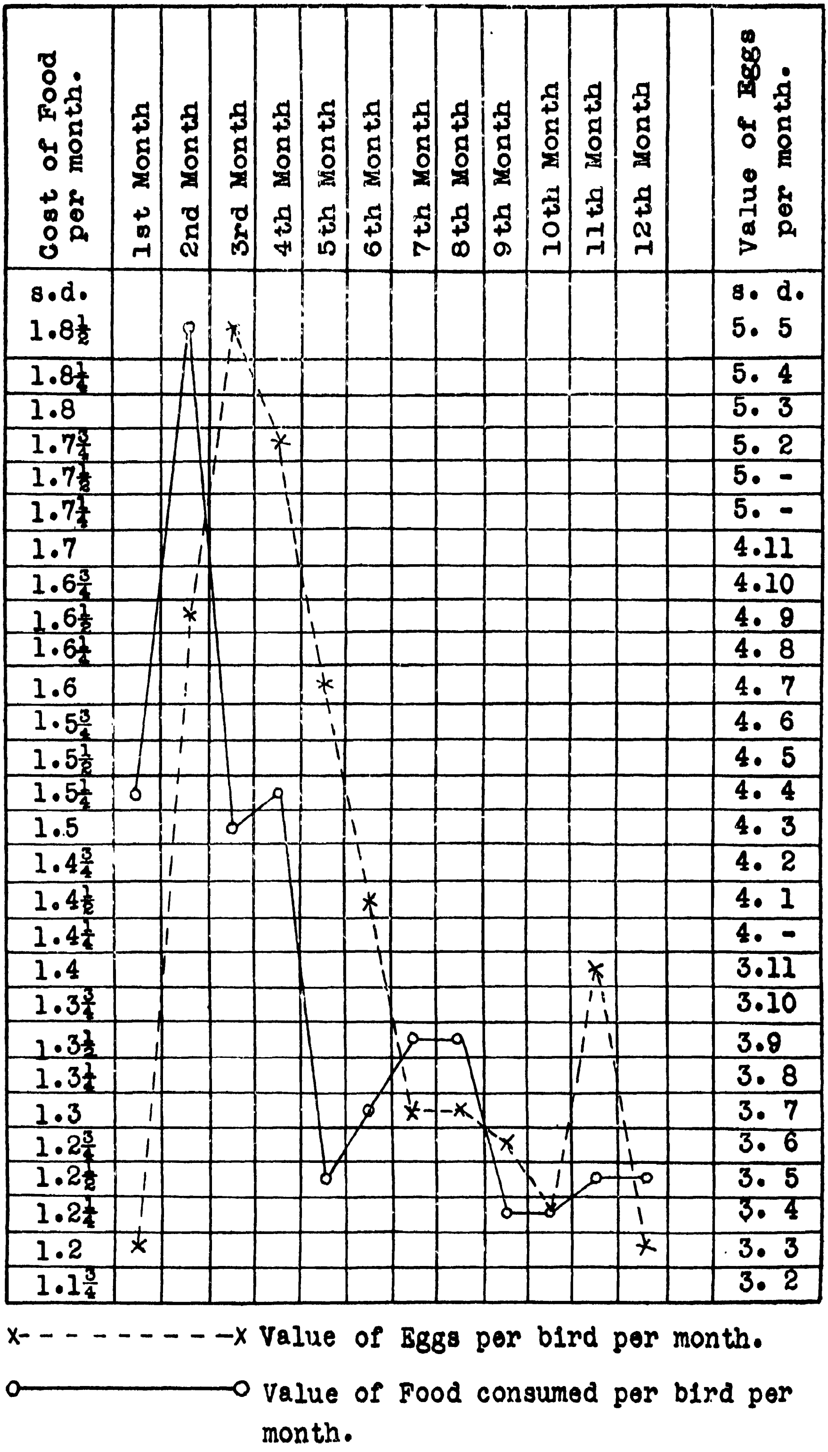
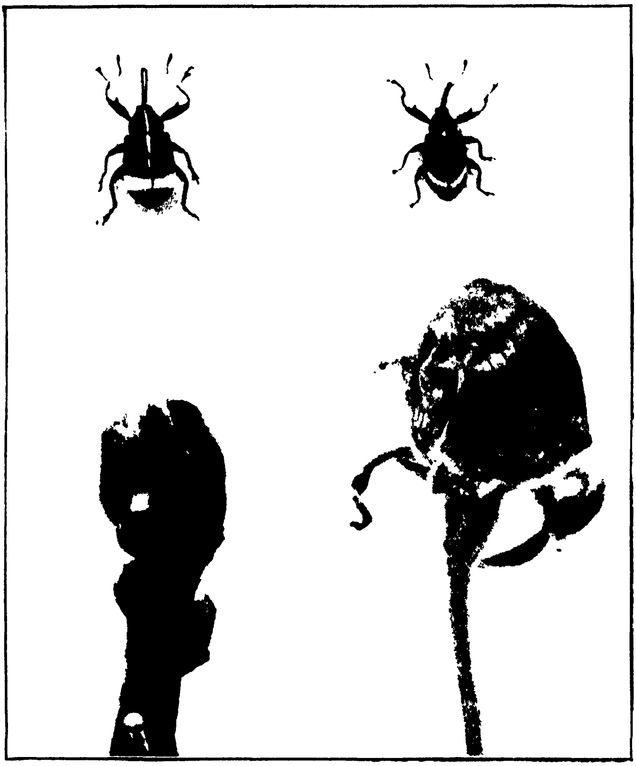


FIG. 1. Average Values of Eggs produced and Food consumed, November, 1919, to October, 1921.



2 1

1. Bud Weevil.
2.—Apple Bud from which a Bud Weevil has emerged.
3. Blossom Weevil.
4.—"Capped" Blossom from which a Blossom Weevil has emerged.

This new weevil, which might perhaps be known as Bud Weevil to distinguish it from the Blossom Weevil, has been familiar on the Continent of Europe for very many years as a pest of pears and to a less extent of apples. In France the insect is called the Pear Anthonomus and also the Winter Worm. In Germany it is known as the Pear Bud Killer or Pear Bud Stinger, while there are also records of its doing considerable damage both in Russia and Italy. In all cases it would seem to be pears which are damaged rather than apples. In comparison with the Apple Blossom Weevil, the pest usually appears to be regarded as of less, and sometimes as of much less, importance. It is of course quite impossible to predict the nature of the losses which it may ultimately cause in Great Britain, while it is almost equally difficult to judge whether the species is really new to our orchards or whether it has persisted for years in small numbers undetected. It is undoubtedly the case that it might easily be carried in the egg stage upon nursery stock from the Continent, and that nothing short of complete prohibition of the entry of such stock could prevent its introduction. On the other hand, if it were a recent arrival in England, it is decidedly unlikely that it would appear simultaneously in two localities so far apart as Kent and Norfolk, and on the whole it is more probable that the insect has been present with us for at all events a number of years and that it may even be native.

In regard to the life history of the new weevil, it is recorded in Germany that eggs are laid in September and October in the leaf and fruit buds of pear trees, that the larvæ are found in the buds from the middle of February and that they pupate at the beginning of May, the beetles emerging from 8 to 10 days afterwards. It is further stated that the beetles appear to "sleep" during the summer and not to reappear until the time for egg-laying in the following autumn. Judging by the behaviour of specimens which were kindly supplied by Mr. Goude (Horticultural Instructor for Norfolk), these statements correspond fairly well with the habits of the insect in Great Britain, and there is every reason to suppose that it will have a similar life history here. Mr. Petherbridge, however, is investigating the matter and may shortly be able to confirm or correct these notes.

In the meantime, it is suggested that pear and apple growers should be on the look out at the end of winter and early spring for buds which have been killed or have failed to expand, and if on examination they are found to contain grubs, the Ministry would be grateful for full particulars.

A LOCAL INVESTIGATION OF THE FOOD OF THE LITTLE OWL.

WALTER E. COLLINGE, D.Sc., F.L.S.,
Keeper of the Yorkshire Museum, York.

ON the publication of my report on the food and feeding habits of the Little Owl,* I received a letter from Mr. M. Portal inquiring if I would like to have specimens of this bird from a series of localities in Hampshire from the end of May to the middle of July. Mr. Portal was of opinion that the critical months were June and July "when one might have wished for 50 instead of 22 and 14 specimens for investigation." Mr. Portal's kind offer was accepted and he thereupon made arrangements with the owners and keepers of several estates. In all 98 birds have been received from different localities. Of these 2 were received in May, 39 in June, and 55 in July. In two cases the stomachs were empty, and are therefore not included in these figures. Specimens have been received from 27 different estates, or an average of 3.63 from each.

In considering the results obtained it must be borne in mind that this is a purely local investigation, and as Dr. Ritchie has pointed out,† if we limit the area covered by any one study of the food of birds, "the farmer in any particular locality begins to see that the statistics of the laboratory have some close relation to the facts which force themselves upon his notice throughout the year," and he will "begin to put faith in the conclusions drawn from necrological surveys." That the value of such local investigations is considerable probably no one will deny, but the danger is that those who read the results of such will jump to the conclusion that these are typical of the particular species of wild bird throughout the whole country, whereas they only indicate the feeding habits of the species in a limited area, and such habits are modified or vary according to the particular nature of the locality, *i.e.*, whether agricultural, horticultural, game-breeding, moorland, etc. In Hampshire and the surrounding district there is a large quantity of game-birds bred.

Food of the Adult.—Of the total bulk of food consumed by these 98 specimens during May, June and July, 91.57 per

* *Journal of the Ministry of Agriculture*, Feb., 1922, p. 1022, and March, 1922, p. 1133.

† *Scottish Naturalist*, 1918, p. 255.

cent. consisted of animal matter, and 8.43 per cent. of vegetable matter. Of the animal content 57.34 per cent. consisted of insects, 20.28 per cent. of earthworms, 7.71 per cent. of voles and mice, 2.94 per cent. of wild birds (mostly house-sparrows) and 1.78 per cent. of game birds and poultry.

Wireworms and click beetles constituted 10.10 per cent. and cockchafers and their larvæ 5.10 per cent. of the insect content. The neutral insects consisted in the main of Dung Beetles (Geotrupes) and a few small moths.

Monthly Percentages of the Principal Food Items of the Adult Little Owl.

Kind of Food.	May.	June.	July.	Average.
Seeds of Weeds	—	·14	—	·05
Miscellaneous Vegetable Matter ...	—	16·15	9·00	8·38
Slugs or Snails	—	·12	—	·04
Injurious Insects	—	10·64	41·27	17·30
Beneficial Insects...	—	1·15	·54	·56
Neutral Insects	52·50	42·30	23·63	39·48
Voles and Mice	—	8·96	14·18	7·71
Wild Birds	—	7·82	1·00	2·94
Game Birds	—	5·25	·09	1·78
Earthworms	47·50	7·43	5·91	20·28
Miscellaneous Animal Matter	—	·04	4·38	1·48
Total	100·00	100·00	100·00	100·00

If we add these food percentages to those previously obtained and take the average we find a general corroboration of the nature and quantities of the food even in a local investigation.

Comparison of the Food Percentages of two Investigations and Averages.

	Previous Investigation.	Present Investigation.	Average.
Seeds of Weeds	·55	·05	·30
Miscellaneous Vegetable Matter	5·96	8·38	7·17
Slugs or Snails	·02	·04	·03
Injurious Insects	30·62	17·30	23·96
Beneficial Insects	·99	·56	·77
Neutral	17·63	39·48	28·56
Voles and Mice...	31·05	7·71	19·38
Wild Birds	4·45	2·94	3·70
Game Birds	·51	1·78	1·14
Earthworms	7·83	20·28	14·05
Miscellaneous Animal Matter ...	·39	1·48	·94
Total	100·00	100·00	100·00

Summary and Conclusion.—The results obtained by this further investigation of the stomach contents of 98 birds taken in a local area where game birds are very generally reared, shows that the bulk of this bird's food during June and July consists of neutral and injurious insects, voles and mice, and earthworms. In comparison with other food items the amount of game birds is infinitesimal.

As has been previously stated the writer does not contend that the Little Owl does not destroy young game birds—it is well known that it does—but the actual percentage of this kind of food is so small, that, under ordinary circumstances, it is negligible. On the other hand it must be borne in mind that the bulk of its food is of such a nature that it must be regarded as of great value to the agriculturist. If we were to reverse these figures, viz., 17.30 per cent. of injurious insects, 7.71 per cent. of voles and mice, and 1.78 per cent. of game birds so that they were 25.01 per cent. of game birds and 1.78 of injurious insects, then there might be cause for alarm, for it would prove that the Little Owl was not an insect feeder or a destroyer of voles and mice, but that the bulk of its food consisted of game and other birds, but this cannot be stated even for the months of June and July, and during the remainder of the year the nature of the food is such that no unprejudiced mind can do other than admit that as a factor in the destruction of injurious insects and voles and mice, the Little Owl is a most valuable ally.

In conclusion, the writer wishes to express sincere thanks to Mr. M. Portal for the trouble, time and expense he has taken, and also to the various land-owners and their keepers for their kindness in forwarding specimens.

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NOTES ON MANURES FOR NOVEMBER.

SIR JOHN RUSSELL, D.Sc., F.R.S.,
Rothamsted Experimental Station.

Does Good Farming Pay?—During the past three months many farmers must have asked themselves the question whether it is worth while to farm well. With prices fallen to the present level there must be many who wonder if it would not be better to cut down all expenditure and reduce all their outgoings to a

minimum. There is high authority for the dictum that high farming is no remedy for low prices. It was Lawes himself in 1879 (a time when as at present farmers were faced with a crisis and when land was going down to grass, labour was being reduced and the standard of farming was falling) who impressed upon farmers the fact that large dressings of manures do not necessarily bring in high profits. To enforce this point he quoted the results of some of the experiments on the growth of wheat on Broadbalk field, Rothamsted. Four plots were set out and dressed with artificials, the dressings being as follows :—

	Average per acre per annum. Dressed corn.	
		Straw.
Wheat every year, 27 years, 1852-78.	*Bushels.*	*Cwt.*
Complex mineral manure, alone	15¾	13½
" " " and 200 lb. ammonium salts ...	24½	22¾
" " " " 400 lb. " " ...	33¼	33¾
" " " " 600 lb. " " ...	36¾	40⅜
Barley every year, 6 years, 1852-57.		
Superphosphate alone	31⅝	16½
" and 200 lb. ammonium salts	45½	28⅜
" " 400 lb. " "	49⅜	34

The complex mineral manure consisted of 3½ cwt. superphosphate, 200 lb. sulphate of potash, 100 lb. sulphate of soda and 100 lb. sulphate of magnesia per acre, or just over 7 cwt. in all. The results showed that the 2 cwt. sulphate of ammonia in addition to other artificials gave an increased yield of 8¾ bushels per acre, while 4 cwt. sulphate of ammonia gave an increased yield of 17½ bushels, but 6 cwt. gave an increase of only 21 bushels.

From these figures it is evident that an increase in the total artificials from 11 cwt. to 13 cwt. per acre increased the yield of grain only by 3½ bushels per acre, and was therefore clearly unprofitable. Lawes concludes: "Assuming that the application of 400 lb. of ammonia-salts was the limit of high farming with wheat at 6s. per bushel I cannot see how it could be maintained that a further 200 lb., yielding little more than a third as much increase as when used in more moderate quantity, should be employed because the price of wheat was reduced to 5s. per bushel. On the contrary, the conclusion I should draw from the results of these experiments is that the application of the 600 lb. of ammonia-salts could only be profitable if the price of wheat were to rise instead of fall." Everyone would agree with this.

If any farmer were giving his wheat crop 11 cwt. of artificials per acre, including 4 cwt. of sulphate of ammonia, we could

quite certainly advise him that he would gain nothing, and probably lose, by adding still another 2 cwt. of sulphate of ammonia, making 13 cwt. of artificials in all. So far as dressings of this size are concerned there is no reason at all to suppose that they are profitable.

No farmer nowadays, however, uses anything like these quantities of artificials on wheat, not even the 4 cwt. of sulphate of ammonia which Lawes spoke of as the possible limit, and therefore the results are not directly applicable to modern practice. The experiment tells us nothing at all about the behaviour of the wheat crop with smaller dressings such as 1 cwt. or 1½ cwt. of nitrate of soda or sulphate of ammonia with or without 1 to 2 cwt. of superphosphate. Is it worth while using these? It is obviously very unsafe to say that because it does not pay to give 13 cwt. of artificials to wheat, therefore it does not pay to give 1 or 2 cwt. The experiment, in other words, cannot properly be quoted in relation to the modern problem. A more applicable experiment is now in hand at Rothamsted, and while the results are not all available those to hand suggest that the old conclusion does not apply to dressings of the size ordinarily given by farmers. There are also recent experiments on other crops that do not agree with this old conclusion. At the Midland Agricultural College an interesting experiment was made on Arran Chief potatoes in 1921. The whole field received 12 tons of farmyard manure per acre, but the various plots received different quantities of a mixture of artificials (3 cwt. superphosphate, 1 cwt. sulphate of ammonia and 1 cwt. sulphate of potash). The results were as follows:—

Plot	*Manuring.*		*Yield in tons per acre.*	*Percentage Ware.*	*Percentage Seed.*	*Value of Crop at £6 per ton, Seed and Chats £2 per ton.*	*Cost of extra Manure at 4/- cwt. for Superphosphate, 15/- cwt. Sulph. Amm., 15/- cwt. Sulphate of Potash.*	*Profit or loss from additional Dressing.*
	Dung	*Artificials*				£ s. d.	£ s. d.	£ s. d.
1	12 tons	6 cwt.	11·31	53·1	42·3	46 13 0	—	—
2	12 ,,	8 ,,	13·63	56·9	39·3	58 5 0	0 17 0	+10 15 0
3	12 ,,	10 ,,	14·36	60·6	35·7	63 10 0	1 14 0	+15 3 0
4	12 ,,	12 ,,	13·19	61·7	33·2	58 18 0	2 11 0	+ 9 14 0
5	12 ,,	14	13·18	52·9	1·2	54 5 0	3 8 0	+ 4 4 0
6	12 ,,	16 ,,	11·34	58·4	38·3	49 3 0	4 5 0	− 1 15 0

Now it is quite obvious that the heaviest dressing (16 cwt. artificials per acre in addition to 12 tons farmyard manure) has not paid: nor has 14 cwt. paid as well as 12 cwt.; but it would be quite wrong to argue that therefore a farmer should not use artificials at all. As a matter of fact the highest profit is obtained not by the lowest dressing but by the 10 cwt. of artificials in addition to the dung. A similar result is obtained if the potatoes are written at half the cost. The true conclusion is that if it pays to grow a crop at all it pays to grow a good one, and a farmer should endeavour to find out what is the most advantageous quantity of fertiliser to use: he will not want to give too much, but he may lose if he gives too little. No one can say beforehand exactly what this quantity is, and nothing but experiment will show it; but an expert with local knowledge can give useful help.

Grass Land.—In time of financial trouble farmers look to grass to tide them over their difficulties and undoubtedly this is a safe plan. If, however, grass is to give all the help it can it must be properly treated. Fortunately this is not necessarily a costly matter, and poor grass can commonly be improved at a relatively small expenditure. Grazing land requires first and foremost good stocking. Professor Gilchrist has obtained striking results from mixed grazing at Cockle Park, the gain in live weight of the animals per acre being about doubled when sheep and cattle were used instead of sheep alone. He states "sheep graze only the fine bottom herbage and reject that of a stemmy character, whereas cattle graze much more evenly and not so closely. When a pasture is grazed with horses large areas soon become coarse and benty where their droppings are deposited and very bare on the parts where they graze. It is of the greatest importance that a pasture should be grazed closely at least once a year."

Assuming good grazing, considerable further improvement may be obtained by the use of basic slag or mineral phosphates. So much has been written about basic slag that it might seem superfluous to say more were it not for the fact that one can still find grass land that obviously needs it. Experiments have not shown that one kind of slag is invariably better than another, but there are a number of cases where high soluble slag has acted better than one of low solubility. Numerous experiments are being made in the various counties and the results should before long be available. Farmers are, however, becoming increasingly interested in mineral phosphates owing to their relative cheap-

ness. The following table has been drawn up by Professor Gilchrist* :—

COMPARATIVE COSTS OF SOME PHOSPHATIC MANURES IN THE SPRING OF 1922.

Manure.	*Phosphate.*	*Price per ton†.*		*Price per unit.*		*19 units per acre in.‡*	*Cost per acre.*	
	%	s.	d.	s.	d.	cwt.	s.	d.
Basic slag	38	101	0	2	8	10	50	8
Basic slag	22	62	6	2	9	$17\frac{3}{11}$	52	3
Ground American phosphate ...	70	125	0	1	9	$5\frac{3}{7}$	33	3
Ground African phosphate ...	60	115	0	1	11	$6\frac{1}{3}$	36	5
Superphosphate (soluble) ...	30	95	0	3	2	$12\frac{1}{3}$	60	2

Slags and mineral phosphates are both guaranteed to be 80 per cent. fineness (*i.e.*, passing sieve with 100 meshes to the linear inch). Satisfactory results have been obtained by Professor Gilchrist with some of the mineral phosphates especially when very finely ground (80 per cent. passing a sieve with 120 meshes to the linear inch). In one case the result appeared to be as good as, if not better than, that produced by high grade basic slag. With less fine grinding the results are less satisfactory.

The question often arises whether lime is needed in addition to basic slag. In many cases it is not, but the rule is by no means absolute. Dr. J. A. Hanley has found soils in Yorkshire which are so sour that basic slag does not act until lime is added, but then a remarkable effect is produced. Probably other soils of the same character could be found; where basic slag has not given the effect which might have been expected it is worth while consulting the county organiser with the view of having the soil examined.

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NOTES ON FEEDING STUFFS FOR NOVEMBER.

E. T. HALNAN, M.A., Dip. Agric. (Cantab.),
Ministry of Agriculture and Fisheries.

The Use of Home-Grown Feeding Stuffs for Stock Feeding.—The prices of home-grown feeding stuffs, usually sold off the farm, have now reached the stage when it becomes more economical for the farmer to feed his grain crops to stock rather than to sell them for human food and purchase cakes

* Field experiments with Rock Phosphates and Basic Slag were described in this *Journal* for September and October, 1922, and a further article appears in this issue, p. 706.

† Carriage paid to farmers' stations.

‡ Containing nearly 200 lb. phosphoric acid.

and other foods for winter feeding. Notes have already appeared in a previous issue of this *Journal* (September, 1922, p. 562) on the use and method of feeding potatoes to stock. Several farmers have inquired about the chief points to consider in feeding grain crops, such as wheat, rye and barley. All farmers are sufficiently familiar with the value and use of oats to warrant not dealing with them in these notes, but it is evident that barley, rye and wheat are somewhat unfamiliar feeding stuffs from a stock feeder's standpoint. One of the first points to note about grain crops is the fact that they are all somewhat starchy foods, deficient in digestible protein. The nutritive ratio of barley is 1 : 10, and that of rye and wheat 1 : 7. Most farm rations for stock vary from 1 : 4 to 1 : 6, 1 : 6 being the most common ratio. It becomes necessary therefore, in feeding barley, rye or wheat to give in addition some nitrogenous supplement, such as fish or meat meal, earthnut cake or decorticated cotton cake.

A possible alternative method of supplying this protein deficiency is to feed legume hay, such as tare or oat hay, or clover hay as the bulky part of the ration.

One of the chief difficulties met with in feeding grain crops is to know how best to use them. Wheat is generally so hard that digestive troubles will occur unless it is cracked or broken. On the other hand, if it is too finely ground, the meal forms a pasty mass in the mouth and the stock find it almost a physical impossibility to eat it. Wheat should always therefore be fed in a cracked or broken state and should preferably first be soaked.

For pig feeding, barley, wheat and rye are best fed in the form of a coarse meal, soaked at least 12 hours before feeding.

For horses, both wheat and barley can be used in part replacement of oats. Barley may be fed whole, but wheat should be cracked. Rye can also be used for horses, and should be well soaked before feeding. The writer is aware of a farmer whose usual practice is to feed rye alone, well soaked, and his horses are kept in very good condition. Clover and vetch hay form the bulky part of the ration and the horses are fed on green vetches without any concentrated food throughout the summer.

With cows and bullocks, wheat and barley may form from one-third to one-half of the concentrated feeding stuffs given in the ration. The recommendations given above for horses apply equally to milch cows.

DESCRIPTION.	Price per Qr. s.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv. s.	Price per lb. Starch Equiv. d.
Wheat, British	42/-	504	9 7	0 17	8 10	71·6	2/4	1·25
Barley, British Feeding	34/-	400	9 10	0 16	8 14	71	2/5	1·29
„ Canadian No. 3 Western	36/-	400	10 2	0 16	9 6	71	2/7	1·38
Oats, English White	29/6	336	9 17	0 18	8 19	59·5	3/0	1·61
„ „ Black & Grey	26/6	336	8 17	0 18	7 19	59·5	2/8	1·43
„ Chilian	28/6	320	9 19	0 18	9 1	59·5	3/1	1·65
„ Canadian No. 3	31/6	320	11 0	0 18	10 2	59·5	3/5	1·83
„ „ No. 2 Feed	28/9	320	10 1	0 18	9 3	59·5	3/1	1·65
„ American	28/3	320	9 18	0 18	9 0	59·5	3/0	1·61
„ Argentine	29/-	320	10 3	0 18	9 5	59·5	3/2	1·70
Maize, Argentine	41/9	480	9 15	0 15	9 0	81	2/3	1·20
„ American	37/6	480	8 15	0 15	8 0	81	2/0	1·07
„ South African	39/-	480	9 2	0 15	8 7	81	2/1	1·12
Beans, Rangoon	8/-	112	8 0	1 16	6 4	67	1/10	0·98
Millers' offals—								
Bran, British	—	—	6 0	1 13	4 7	45	1/11	1·03
Broad Bran	—	—	7 5	1 13	5 12	45	2/6	1·34
Fine middlings (Imported)	—	—	9 0	1 5	7 15	72	2/2	1·16
Coarse middlings (British)	—	—	8 5	1 5	7 0	64	2/2	1·16
Pollards (Imported)	—	—	6 15	1 10	5 5	60	1/9	0·94
Barley Meal	—	—	11 0	0 16	10 4	71	2/10	1·52
Maize „	—	—	9 15†	0 15	9 0	81	2/3	1·20
„ „ S. African	—	—	9 10	0 15	8 15	81	2/2	1·16
„ Germ Meal	—	—	9 5	1 2	8 3	85·3	1/11	1·03
„ Gluten-feed	—	—	9 0	1 10	7 10	75·6	2/0	1·07
Locust Bean Meal	—	—	9 0	0 11	8 9	71·4	2/4	1·25
Bean Meal	—	—	13 10	1 16	11 14	67	3/6	1·87
Fish „	—	—	14 0	4 14	9 6	53	3/6	1 87
Linseed	—	—	19 10	1 15	17 15	119	3/0	1·6 1
„ Cake, English (9% oil)	—	—	12 10	2 5	10 5	74·	2/9	1·47
Cottonseed „ English (5% oil)	—	—	7 15	2 0	5 15	42	2/9	1·47
„ „ Egyptian (5% oil)	—	—	7 10	2 0	5 10	42	2/7	1·38
Coconut Cake (6% oil)	—	—	9 0	1 16	7 4	73	2/0	1·07
Palm Kernel Cake (6% oil)	—	—	7 5†	1 6	5 19	75	1/7	0·85
„ „ Meal (1½-2% oil)	—	—	5 15	1 7	4 8	71·3	1/3	0·67
Feeding Treacle	—	—	4 12	0 12	4 0	51	1/7	0·85
Brewers' grains, dried, ale	—	—	7 10	1 10	6 0	49	2/5	1·29
„ „ „ porter	—	—	7 0	1 10	5 10	49	2/3	1·20
„ „ wet, ale	—	—	1 1	0 7	0 14	15	-/11	0·50
„ „ wet, porter	—	—	0 15	0 7	0 8	15	-/6	0·27
Malt culms	—	—	8 10†	2 1	6 9	43	3/0	1·61

† At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of September and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 9s per ton. The food value per ton is therefore £8 11s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 3d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·21d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

In the case of young pigs, the chief point that arises is whether it is possible to do without middlings, which prove of such value to young pigs at the time of weaning. For such a purpose a mixture of oats and wheat, half and half, ground to a medium fine meal, might be used to replace middlings in the ration.

* * * * * *

THE following note has been communicated by Mr. J. L. Whytehead, one of the Ministry's Inspectors:—

Recent Advances in Poultry Keeping in Gloucestershire.

The County of Gloucester is rapidly improving its position as an egg producing district. The breeds of poultry kept are either the light breeds for egg production or the dual purpose breeds, and purely table breeds are rarely seen. The Ministry's Egg and Day Old Chick Distribution Scheme has been in operation in Gloucestershire for several seasons and has no doubt helped to show the advantages of keeping well bred stock. Under the scheme trap-nested stock of the utility breeds of hens and of ducks are obtainable by cottagers, small-holders and allotment holders.

Full advantage has been taken of the instruction in poultry keeping provided by the County Agricultural Education Committee. During the last two winters evening lectures in poultry keeping were given by the Poultry Instructor in widely scattered districts, the days being spent in visits of advice. Models of trap-nests, dry mash hoppers and drinking fountains, made from materials which were practically waste, were exhibited at every lecture and were often left behind to be copied by poultry keepers in the district. At the end of each lecture the names and addresses of those who wished to be visited were noted. It gradually became known that a whole-time poultry instructor was available, and the number of requests for advice, for lectures, and for judging at local shows rapidly increased. A stand is erected at the more important shows in the county showing specimens of good and bad types of laying hens, good and bad foods, appliances and samples of medicines, and visitors are invited to ask questions.

One result of the work done during the last two years is that about 5,000 more hens are being trap-nested than was the case previously. In many villages there are poultry keepers who can produce the records of eggs laid by their hens, and in some cases by their ducks. Many of these more advanced poultry keepers are reaping a good reward.

This autumn a laying test has been started for birds belonging to residents in the county of Gloucester only. The necessary funds are being obtained by subscription. The start is in a small way, but it is hoped that the standard will be high. Fifty pens have been arranged for pullets, and ducks are also being catered for.

The importance of poultry keeping by general farmers cannot be overlooked; indeed, some of the largest and most successful of the poultry farms in the county are the property of general farmers who have acquired an expert knowledge of poultry.

The large poultry farm has come more into evidence in recent years, and there are now about a dozen farms in Gloucestershire where more than 1,000 head of laying stock are kept, and a large number with from 500 to 1,000. There are eight Mammoth Incubators in use in the county, nearly all having been erected recently.

Two large egg-collecting depots are in existence at Cirencester and Nailsworth. At the former over one and a quarter million eggs were handled in 1921. The commercial egg farmer who sends his eggs direct to the large markets in many cases dispatches the consignments by goods train and this practice is increasing. It is found that there are fewer breakages than when sent by passenger train and the cost is much less.

Gloucestershire is an important fruit growing county and for this reason alone should carry a large stock of poultry. These two branches of farming go very well together. Mr. P. M. Hinton has kept poultry in some of his orchards near Tewkesbury for over 12 years with noticeably good results. The apple trees in these orchards have borne good crops for each of the past four years, including the years 1919 and 1920, which were generally bad apple years in this district. The growth of new wood has been very strong and it has been noticed that the young fruit trees on the land under poultry have matured more quickly than similar trees on adjoining ground not under poultry.

The keeping of a large number of birds on these orchards has enabled the owner to maintain the trees in first rate condition, and a very substantial saving of money has been effected in the purchase of manures. A reduction in expenditure on spraying has been possible owing to the destruction of fruit pests by the birds. For example, the Apple Blossom Weeevil is becoming less in evidence each year in those orchards which are stocked with poultry.

* * * * * *

Photo [Moss, Cirencester.

FIG. 1.—The Egg Depôt at Cirencester.

FIG. 2.—A large Laying-House for White Leghorns on a Farm in Gloucestershire.

FIG. 3.—Orchard at Tewkesbury stocked with Poultry.

National Rat Week, 1922.

THE week commencing on Monday, 6th November, 1922, has been fixed by the Ministry as "Rat Week." A memorandum containing suggestions as to the action that may be taken by them and by the public has been issued to all Local Authorities in England responsible for the administration of the Rats and Mice (Destruction) Act, 1919, and it is hoped that all agriculturists will co-operate in securing the greatest possible destruction of these vermin at the time when they are returning to their winter quarters. Although an effort of this kind during one week is not sufficient to keep down rats and mice, but is only a feature in the continuous campaign which a number of local authorities are actively carrying on, it should produce good results not only by the destruction of a large number of rats, but by calling attention to the enormous waste of foodstuffs caused by their depredations, and by reminding the public that it is the duty of all occupiers to destroy rats and mice upon their premises.

The following are some simple suggestions for rat destruction:

Prevention being better than cure, begin by rendering rat-proof as far as possible all ricks, barns and granaries. In urban districts see that drains are intact.

To destroy rats proceed as follows:—

(i) Provided the Local Authority has appointed an officer under the Act, consult him, and, if he is authorised, entrust the destruction to him.

(ii) If you prefer to undertake the destruction yourself, consult a local chemist, asking for poisons containing Red Squill or Barium Carbonate. If there is absolutely no danger to domestic animals or human beings, one of the standardised phosphorus preparations is effective.

(iii) If you wish to make your own bait, the following recipes will be found effective:—

(*a*)	Barium Carbonate (Commercial)	6 oz.	This will make 1,000 baits of 6 grains each, *i.e.*, pieces as large as a hazel nut.
	Meal	16 oz.	
	Dripping	4 oz.	
	Salt	½ oz.	
(*b*)	Barium Carbonate (Commercial)	4 oz.	Mix with fat to a paste and lay out in pieces the size of a hazel nut in places where rats frequent.
	Biscuit or Oat Meal	4 oz.	
	Oil of Aniseed	5 drops	
		per cent.	
(*c*)	Barium Carbonate (Commercial)	20	Thoroughly mix the ingredients. A bait is one dessert spoonfull wrapped in a twist of tissue paper.
	Fine Castor Sugar	40	
	Fine Meal	40	
		per cent.	
(*d*)	Squill (Red Powder)	20	Crumble bread. Mix ingredients to paste and apply as in (*a*) and (*b*).
	Bread	30	
	Fat	30	
	Syrup	20	
	Aniseed...	6 drops	

Note.—Reasonable care should be taken when using Barium Carbonate bait to prevent domestic animals or poultry obtaining access thereto.

Gassing Rats.—Sulphur dioxide, applied from a Clayton machine or a cylinder, as well as carbon bi-sulphide properly applied, can be used to gas rats. Acetylene gas, generated by water dripping on calcium carbide, can also be used.

Traps.—"Six-inch" rabbit traps are more humane than the smaller ones generally used. Breakback traps properly set are good. Gins and snares catch many rats in a countryside.

Dogs and Ferrets are useful to clear an area after poisoning, and give good sport.

Mice.—The poisoned baits for destroying rats will also kill mice, but the bait should be smaller. Traps are used with greater effect to catch mice than rats. Keep pantries and food stores under proper supervision and see that the food of birds in cages cannot be got at by mice.

* * * * * *

A Modern Method of Rat Destruction.

SINCE the introduction of the Rats and Mice (Destruction) Act, 1919, the Ministry of Agriculture, County Councils, and other local governing bodies have adopted various means to fight the rat menace of the country.

The most recent and efficacious method is the use of sulphur dioxide gas. The gas is generated within a cylindrical vessel by burning sulphur and the sulphur dioxide is forced, by means of a fan, to the rat runs through a flexible metallic tubing at high pressure. Within four or five minutes the rats are suffocated, provided that care has been taken to block the exits to prevent bolting. It is well to have two or three well-trained dogs stationed near by to kill rats which may bolt from holes overlooked.

The bucks are generally the first to bolt. Does which have a litter will remain with their young to the end. A rat that bolts after the first minute or so of gassing is usually partly overcome and is an easy prey for the dogs.

By excavation of a portion of the area thus treated, sufficient evidence of the efficiency of this method may be obtained; also a point worth mentioning is the fact that other rats will be reluctant to establish themselves in the same place.

In this manner large rat-infested areas may be thoroughly and expeditiously treated. It is applicable on estates, farms, hedgerows, railway embankments and buildings of all kinds.

It is, however, only by active and determined co-operation between occupiers of rat-infested zones and the administrative authorities that the rat danger in this country will be controlled and will eventually be brought down to a minimum.

* * * * * *

THE following note has been communicated by Mr. N. B. Bagenal, until recently one of the Ministry's Inspectors:—

Hereford Fruit Market: Sale of Guaranteed Lots by Sample.

An interesting experiment in methods of marketing is being carried out this season by the Hereford Fruit Market, which for many years has been controlled by the Corporation of that City. The bulk of the fruit is marketed in wicker pot-baskets manufactured by the Corporation from osiers grown on the Town Sewage Works, and hired out to the vendors at 2d. per week.

During last season, considerable difficulty was experienced at the weekly sales, owing to the number of lots being too large for displaying in rows under shelter. To meet this difficulty, arrangements have this year been made to supply with the pot-basket a withy cover, not attached to the pot, but easily attachable. Fruit so packed is stacked on arrival, and one pot from each lot is exposed as a sample. By stacking, it is found possible to accommodate at least twice as many packages under cover as it was when all were exposed.

To allow of sale by sample, an official label is issued to all vendors who use the withy cover. To each pot marketed under this system, is attached one of these labels bearing a guarantee of variety, grade, and net weight of fruit, filled in and signed by the grower, and giving his address. To meet the demands of growers for non-returnable packages, the Market Authorities supply the British Federation Standard Box (40 lb.) made up, or in the flat. These are sold to the vendor at a trifle over cost price, and a charge of 5d. is made to the purchaser. It is proposed to hold three special box sales during the course of the season.

The Market Authorities retain responsibility for all purchased lots, until they are delivered, ready packed, to the local representatives of the various railways, whose vans come to the market during and after the sale to collect the fruit. In this way the purchasers are spared all trouble with regard to the packing and despatch of their fruit from the market, and to those who come from a distance this is a distinct advantage.

It is to be noted that the Market Authorities have not attempted to enforce the system of sale by sample to the exclusion of the former method. Fruit is still sold in pots without covers or in any reasonable form of package; but when the withy cover is used in conjunction with the pot-basket, then the guarantee label must be used also.

While it must be admitted that the prices obtained for lots sold by sample have not, so far, proved highly satisfactory, it should be remembered that the system is new to the district, and that purchasers are necessarily cautious with any new system until it has been thoroughly tried and has passed the test.

The first object of the change, namely, economy of space under shelter, has been attained, and on a wet market day the advantage thus offered to those whose packages are under cover, is particularly noticeable. It is, moreover, generally conceded by the purchaser that pot-fruit provided with withy covers travels better, and with less risk of pilferage, than when packed in the old way.

Growers who have used the guarantee label under the new system have loyally upheld the good traditions of the market, and the Authorities have had practically no complaints from the purchasers on the score of topping. This being so, there can be little doubt that the Hereford Corporation are on sound lines in their new undertaking, and if the market slogan of "Good Fruit, Fairly and Honestly Packed and Correct to Weight" is generally adopted throughout the district, there is every hope that this enterprising project will meet with all the success it deserves.

* * * * * *

Gulval Fruit Plot.

SITUATED on the hills at the back of Penzance there is a small plot of land—just two acres in extent—which is known as the Gulval Fruit Plot. It has been used by the Education Committee of the Cornwall County Council for experimental purposes since 1898. In the first instance, one half was planted with fruit and served to demonstrate that apples and pears could be raised in the Penzance district of sufficiently good quality to realise top prices in the London markets; the other half was used for asparagus and vegetable production on French gardening lines.

The growers in the district (Gulval, Marazion, etc.,) are, however, not as interested in fruit growing as in the culture of early potatoes and broccoli, which must be regarded as the principal crops of the Penzance area. The Cornish grower, who is unable to produce his potatoes as early as the grower in the Channel Islands and Isles of Scilly, aims at raising a crop by the second week in May, and in normal years these are the first home-grown potatoes in the market. Earliness is the main factor, and only a few varieties such as Duke of York, May Queen, Sharpe's Express and Advance have proved of much

value. Experiments conducted at Gulval to test (*a*) the capacity of all the early varieties, and (*b*) the effect of sprouting the tubers in boxes, should provide valuable new information to those Cornish growers who have too long followed the same system.

The Penzance area, in virtue of its temperate winter climate, is able to mature broccoli in mid-winter when growth in other districts has been almost stopped. Yet the district has its defects—the winds are strong and bring with them salt sea sprays which coat the plants, and only a few varieties, it is stated, can withstand this treatment. For very many years the variety of broccoli chiefly grown has been the Penzance Early—a good, hardy, heavy-cropping variety with coarse heads of a yellowish colour. This is not an ideal variety and experiments are needed to discover a suitable broccoli possessing a smoother curd and better colour and more suited to present markets. It is understood that provision has been made at the Gulval plot for trials during 1922 of a large number of varieties of broccoli. Such experiments should be watched closely by the Cornish growers and by broccoli growers in general.

* * * * * *

Yorkshire Fruit Demonstration Station.

The increasing population in the industrial parts of the north of England has created a large demand for fresh fruits and vegetables, which in the past has been met by supplies from the south of England and from overseas. In recent years there has been more planting of fruit on a small scale around Hull and York, and the area devoted to vegetables at Selby has possibly increased, but in the main little effort has been made by growers in Yorkshire to change their methods of farming by substituting fruit and vegetables for grass, cereals or roots. Culture of this character, which is of an intensive nature, requiring skill and detailed attention, could be undertaken by many of the small holders recently settled in those parts of Yorkshire where the soil is suitable.

The Yorkshire Council for Agricultural Education, to encourage this movement, has decided to establish a few demonstration centres throughout the county, the first having been established at Osgodby in 1920. A plot of land of 4½ acres, originally intended for a small holding, has been given over for this purpose, on which there have been built a typical small holder's house, a shed for tools, packing shed and store-room complete. The land, which consists of a poor sandy soil, has been well cultivated and

fully planted to top and bush fruit. There is a general slope to the south, and a sheltered belt of standard trees of Hessle Pears Merryweather and Farleigh Damsons, and John Downey Crab Apples has been planted. These prolific pollen-bearing trees should also assist in ensuring a good fertilisation of the quality fruit trees proper. The apples chiefly planted are Worcester Pearmain, King of the Pippins, Allington Pippin, Cox's Orange Pippin, for dessert, and Lane's Prince Albert, Newton Wonder, and Bramley Seedling for cooking purposes. Beurre Hardy Pitmaston Duchess, and Williams are the chief varieties of pears, and Victoria, Czar, and Early Rivers the principal plums All these trees are propagated on East Malling standardized stocks, and are interplanted with bush fruits of gooseberries and currants, between the rows of which there are grown various kinds of vegetables. The whole is a typical fruit-growing small holding.

The plot has only been established a short time, and it is impossible to predict the results, but it is certain that the plot will be of great use to all fruit growers in the county, by demonstrating the best stocks suitable for the propagation of fruit trees and the best methods of culture, pruning and care of the trees in order to produce fruit of marketable quality. The station should afford a stimulus to small holders in the district to engage in these methods of cultivation.

* * * * * *

The following letter has been sent to all Local Education Authorities :—

6th October, 1922.

Sir,

Clean Milk Production.
Milk and Dairies (Amendment) Act, 1922.

I am directed by the Ministry of Agriculture and Fisheries to ask you to be good enough to bring to the special notice of the Local Education Authority for Agricultural Education the question of instruction in clean milk production in view of the passing of the Milk and Dairies (Amendment) Act, 1922. As your Authority are aware, the Milk and Dairies (Consolidation) Act, 1915, was to have come into operation on 1st September, but in view of the heavy annual expenditure involved in its administration, and the state of agriculture at the present time, this larger measure has been postponed for a further three years In the meantime the Milk and Dairies Amendment) Act reflects in a measure the growing public demand for cleaner milk.

2. The principal features of this new Act relating to the subject of clean milk are as follows:—(1) Local Authorities are empowered—subject to appeal—to refuse to register, or to remove from the register, any milk retailer if they are satisfied that such action is necessary in the interests of public

health. (2) As from 1st January, 1923, milk may not be sold as "Certified," "Grade A" or "Pasteurised" except in accordance with a licence granted by the Minister of Health or with his authority. The conditions under which licences will be issued will be laid down in an Order of the Minister of Health, which will provide for certain modifications of the system at present in operation for the issue of licences under the Milk Orders. (3) A heavy penalty is imposed upon any person who sells the milk of a cow suffering from tuberculosis of the udder where it is proved that he knew, or could have ascertained by ordinary care, that the cow was suffering from that disease.

3. Coupled with the public demand for cleaner milk, there is the economic fact that cleaner milk leads to greater consumption. In other words, it is in the best interests of dairy farmers to send out milk in a clean condition. In very many cases, however, the methods by which clean milk can be secured are too little realised by farmers, and can only be inculcated by systematic instruction and demonstration, which falls within the province of Local Education Authorities.

4. The Ministry realises that many Local Authorities are unwilling to incur substantial additional expenditure at the present time. Although, therefore, the provision of instruction designed to ensure clean milk is of such direct interest to ratepayers that expenditure thereon could be justified even at a time of financial stringency, the Ministry does not wish to press for new appointments of staff or for courses of lectures involving considerable expense. On the other hand, a good deal of valuable work can be done at very little cost, and it is from this point of view that the Ministry trusts that the subject will receive your Authority's earnest consideration. As examples, reference may be made to clean milk competitions and demonstrations.

5. The initiation of clean milk competitions amongst farmers is a movement of some promise. The awards are based on a bacteriological and chemical examination of the milk and an inspection of the equipment and methods in use at the farm. Diplomas are granted to competitors attaining a sufficiently high standard, and money prizes may be awarded to the milkers. Successful competitors have every right to expect, and in some instances have already obtained, a higher price for their milk, and the result of the efforts made by the others cannot but be beneficial, particularly as a concise report on his own conditions of production is sent to each competitor. Competitions of this sort have already been held with success in one or two counties, and are contemplated in others. A leaflet issued by the Bucks County Agricultural Committee on the subject of the competition held by that Authority is enclosed for your information. It will be seen that, apart from the cost of advertising and printing, the competition involved the Authority in very little expense, as the prizes were offered by manufacturers.

6. Demonstrations in clean milk production can be undertaken without considerable outlay, and afford a productive field for effort. The Ministry's technical advisers have recently given much thought to this question, and have prepared a memorandum for the guidance of Local Authorities thereon. A copy of this memorandum is enclosed, and if, after consideration, your Authority wish to proceed with demonstrations of this nature, copies of the plans referred to in the memorandum will be supplied by this Department at a small charge.

7. Several County Education Authorities have already caused their dairy instructresses to attend one of the special courses of instruction in clean milk production for teachers which have been conducted by the University College, Reading. The Ministry is arranging that the College shall repeat these courses, so that those teachers who have not at present had an opportunity to attend may do so.

8. I am also to enclose (1) a copy of a Memorandum on "How to Produce Clean Milk," which embodies the main points of an article on this subject which appeared in the Ministry's *Journal* in April last, (2) a copy of Leaflet No. 151, on "Cleanliness in the Dairy," which the Ministry would like to see distributed widely amongst dairy farmers. Further copies of this leaflet can be obtained from this Office at the rate of 4/- per hundred.

I am, &c.,

A. D. HALL.

* * * * * *

Foot-and-Mouth Disease—There has been no development arising from the outbreak which occurred at Manchester on 24th August last, and the restrictions in that district have now been withdrawn.

On 20th October the existence of disease was confirmed among pigs on premises at Harmondsworth, near Yiewsley, Middlesex. The usual restrictions were imposed in respect of an area within a radius of approximately 15 miles of the infected premises. Owing to the nearness of this outbreak to the Royal Agricultural Hall, Islington, where the Dairy Show was in progress, and to the fact that some of the animals in the show had been brought from places within the prohibited area, the Ministry's veterinary inspectors made an examination of all animals at the show, and were satisfied that none of them showed signs of being affected with foot-and-mouth disease. As a precautionary measure, however, the Ministry prohibited the movement of any animal from the show except by licence of the Ministry. Licences were granted subject to the condition that the animals were detained and isolated for 10 days at the place of destination.

Licensing of Stallions under the Horse Breeding Act, 1918.—Stallion owners in England and Wales who intend to travel their horses next service season are reminded that applications for the necessary licences under the above-mentioned Act may be made as from 1st November. Forms of application can be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

It should be noted also that licences for the past travelling season only remain in force until 31st October, and in accordance with the provisions of the Act, should be returned forthwith to the Ministry. Failure to comply with this requirement renders an owner liable, on summary conviction, to a fine not exceeding £5.

Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE,
By Metchim & Son, Princes Street, Westminster, S.W. 1.

THE JOURNAL

OF THE

MINISTRY OF AGRICULTURE

Vol. XXIX. No. 9.

DECEMBER, 1922.

NOTES FOR THE MONTH.

Appointment of New Minister.

CONSEQUENT on the appointment of Sir Arthur Boscawen as Minister of Health, Lt.-Col. Sir Robert A Sanders, M.P., formerly Under Secretary of State for War, has been appointed Minister of Agriculture and Fisheries.

The Right Hon. the Earl of Ancaster has been re-appointed Parliamentary Secretary to the Ministry.

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Prime Minister's Letter to the National Farmers' Union.

THE following letter addressed by the Prime Minister to the National Farmers' Union, in reply to an inquiry asking for a definition of his attitude to agricultural questions, was published in the Press on 14th November:—

"With further reference to your letter of the 24th ult., I am desired by the Prime Minister to say that he regrets that it has not been possible in the short time available for the Government to come to a final decision as to what measures can be taken to assist the agricultural industry.

"The Government fully realizes the grave difficulties with which agriculture is faced, but it must be recognized that such remedies as subsidies or protective duties on foodstuffs are out of the question under present circumstances.

"At the same time, there are certain directions along which, in the opinion of the Prime Minister, the Government might usefully explore the possibility of helping this great industry. These are:—

"An inquiry with all reasonable dispatch into the subject of agricultural rating and the removal of any unfairness which might be found to exist.

"The promotion of co-operation in the transport and sale of agricultural produce.

"The encouragement of improved credit facilities to agriculturists and the promotion of education and research.

"Useful results might also be obtained from an inquiry into the causes of the great disparity between the price received by the farmer for his produce and that paid by the consumer of food. All these questions are being carefully examined, and there will be no avoidable delay in coming to a decision as to the form in which assistance on such lines can best be given.

"On these lines the Prime Minister believes that it should be possible to build the foundations of a permanent and stable agricultural policy, which will enable the enterprise and industry of the agricultural community to work out its own salvation under fair and reasonable conditions."

* * * * * *

Importation of Canadian Cattle.

IT has already been announced* that the British and Canadian representatives at the Cattle Conference agreed as to the conditions that should apply to the importation of cattle from Canada.

The agreement has now been ratified by the new Cabinet and by the Prime Minister of Canada, and the following summary of the agreement has, with the assent of the Canadian authorities, been authorised for publication :—

Canadian store cattle (*i.e.*, animals born and reared in Canada and rendered incapable of breeding) are to be admitted under the following restrictions :—

(1) The shipment must be from a Canadian port and direct to a port in Great Britain.

(2) For three days immediately before shipment and during the voyage the animals are to be kept separate from other animals and periodically examined by a veterinary officer of the Dominion. A thorough examination immediately before shipment is to be made by the Dominion veterinary officer, who will certify that the animals are not affected with cattle plague, pleuro-pneumonia, foot-and-mouth disease, or mange. During the voyage the examination is to be made daily.

* This *Journal*, November, 1922, p. 676.

(3) The animals are to be landed at specified landing places and there thoroughly examined by the Ministry's veterinary officers. Movement from the landing place is to be controlled by licence in the same manner as the movement of imported Irish cattle is at present controlled. This secures detention of the animals on some farm or other premises for six days, though they may pass to such premises through one market.

The agreement makes provision to secure that the vessels used shall not be capable of infecting the cargo and also provides for effective action if disease should be found in a cargo.

The landing of Canadian cattle capable of breeding will require the authority of a General Order which will be made by the Minister of Agriculture and Fisheries and laid in draft before both Houses of Parliament for thirty days, and if either House before the expiration of that period presents an address to His Majesty against the draft or any part thereof, no further proceedings shall be taken thereon. It is an essential part of any such order that the animals must be accompanied by a certificate by the authorised officer of the Dominion stating that the animals have within one month before shipment been tested effectively for tuberculosis and found free from that disease, and the Minister is given the fullest discretion as to the precautions to be enforced against the introduction of other diseases by these animals.

The Minister is to retain the power to suspend importation of store and breeding animals if cattle plague, pleuro-pneumonia, or foot-and-mouth disease should appear in Canada.

A fee not exceeding sixpence per animal is to be imposed on all imported animals, and compensation is not payable in case of slaughter at the place of landing in consequence of disease being discovered. For administrative purposes imported animals are to be tagged or otherwise marked.

The Canadian Ministers at the Conference undertook that as soon as the necessary Order authorising importation of Canadian breeding stock is in force, the Canadian Government will modify their conditions of importation of British animals so as to make the Canadian and British conditions reciprocal.

The Conference assented to the view that legislation on this subject cannot be limited to Canada but must be capable of adaptation to the requirements of other parts of the British Empire.

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IN view of the present interest in agricultural wages, the following article is reprinted from the *Agricultural Market Report*:—

Agricultural Wages, Prices and the Cost of Living.

In recent discussions as to agricultural wages, reference is usually made on the one hand to the fall in the prices of agricultural produce and on the other to the cost of living. The farmers point out that they are receiving lower prices and cannot consequently continue to pay the same rate of wages as before, while the worker replies that the cost of living has not fallen materially and that he cannot live in comfort on a reduced wage. Whilst conditions vary in different localities and general figures are by no means applicable to individual cases, the Ministry thinks it will be of interest to make such broad comparisons as are possible between the average rates of agricultural wages, the average prices of farm produce, and the cost of living.

For this purpose the agricultural index number which is published monthly by the Ministry is taken as the best indication of the changes in the prices of agricultural produce, and for the cost of living the index number issued by the Ministry of Labour is used. The former shows the average increase in the wholesale prices of British produce sold off the farm in England and Wales, while the latter represents the average increase in the cost of maintaining the pre-war standard of living of working-class families.

In order to make a comparison with these figures the average earnings of ordinary farm workers in England and Wales in 1914 have been taken at 18s. per week. This figure is based on the assumption that the average weekly cash wages of ordinary agricultural labourers in 1914 were about 16s. 9d., and that, in addition, the labourer received certain allowances which were worth on the average about 1s. 3d. per week. Precise accuracy in this matter cannot be attained, but a consideration of the statements made by various authorities suggests that 18s. may be taken as a fairly approximate figure. Comparative figures for 1921-1922 can be based on the rates of wages fixed by Conciliation Committees in areas where agreements have been reached, and on estimates of prevailing wages in the other areas, weighted by the number of workers in the different districts, while for some intervening years the rates fixed by the Agricultural Wages Board can be used. Taking in the first place the seven years from 1914 to 1921 the move-

ment of wages, prices and cost of living was approximately as follows:—

PERCENTAGE INCREASE AS COMPARED WITH PRE-WAR RATES.

Month.		*Agricultural Wages.*	*Prices of Agricultural Produce.*	*Cost of Living.*
August ...	1917 ...	39 ...	97 ...	80
July	1918 ...	69 ...	123 ...	105
May	1919 ...	110 ...	132 ...	105
April	1920 ...	139 ...	199 ...	132
August ...	1920 ...	160 ...	177 ...	155
September ...	1921 ...	135 ...	116 ...	120
October ...	1921 ...	122 ...	86 ...	110
November ...	1921 ...	110 ...	79 ...	103
December ...	1921 ...	105 ...	76 ...	99

It will be seen that agricultural wages rose but slowly and failed to keep pace with the increase in the cost of living up to May, 1919, when an adjustment was made which brought them somewhat above that figure. The further increases in wages granted in 1920 appear to have maintained them above the cost of living figures, and notwithstanding the subsequent decline the rates were on the whole favourable to the workers up to the end of 1921.

If a comparison is made between wages and the prices of farm produce, it will be seen that while the latter rose much more rapidly than wages, they also fell more rapidly, so that by the end of 1921 they had reached a lower level than either wages or the cost of living. At the beginning of 1922 a re-adjustment took place which brought wages more closely into relation with farm prices; but left them rather below the increase in the cost of living.

PERCENTAGE INCREASE AS COMPARED WITH PRE-WAR RATES.

Month. 1922.	*Agricultural Wages.*	*Prices of Agricultural Produce.*	*Cost of Living.*
January	86 ...	75 ...	92
February ...	83 ...	79 ...	88
March	80 ...	77 ...	86
April	79 ...	70 ...	82
May	78 ...	71 ...	81
June	78 ...	68 ...	80
July	78 ...	72 ...	84
August	76 ...	67 ...	81
September ...	75 ...	57 ...	79
October	60 ...	59 ...	78

The movement in the spring and summer of 1922 was slowly downward, but during October wages have been appreciably reduced in almost all districts with the result that, on the

average, they are now not more than 60 per cent. above the pre-war level, an increase which is almost exactly comparable with the position as regards farm produce, but appreciably below the increase in the cost of living.

The figures for wages given above are averages for the country as a whole, but as is well known the pre-war rates of wages varied considerably in different districts and this variation still continues (though to a somewhat less extent than was formerly the case) the areas where exceptionally low rates were formerly paid having benefited by a rise proportionately greater than that obtained in the better paid areas.

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Production of Lactose from Whey.

IN January, 1919, the Ministry, on the recommendation of the Development Commissioners, obtained Treasury authority to establish and conduct an experimental Lactose Factory, grants for the purpose being provided from the Development Fund. A site for the factory was thereupon obtained at Haslington, near Crewe, adjoining the premises of a co-operative cheese factory, but owing to unavoidable delay in carrying out the necessary building work and in obtaining suitable plant, etc., the Lactose Factory did not commence work until February, 1921.

The object of the Factory is to experiment in the extraction of lactose and other products from whey, and to ascertain the economic possibilities of the processes adopted.

The circumstances which caused the Ministry to think that it was both necessary and desirable to establish a factory of this kind are as follows:—

(1) One of the phases in the development of the dairying industry which has taken place during recent years is the establishment throughout the country of dairy depots. Some of these depots are owned co-operatively by farmers, and others belong to private individuals or companies. Some depots have been expressly established for the manufacture of cheese; others are for the purpose of dealing with "surplus" milk, often by converting it into cheese, and the result has been the concentration of cheese-making at depots instead of at farm dairies as heretofore.

Cheese-making gives rise to a by-product—whey—which in bulk amounts to about 85 per cent. of the milk used. It therefore follows that the concentration of cheese-making results in a large bulk of whey being produced at the depots.

When cheese-making takes place on farms, the whey, which has a considerable food value, is largely used for pig-feeding, but in the case of depots the amount is too great for it to be used in this manner; also, owing to its bulk and the cost of transit, it is impracticable to convey it from the depots to the farms for use thereon. Whey is consequently largely wasted all over the country to the extent of millions of gallons annually, and its disposal is, moreover, a source of considerable embarrassment to many cheese-making depots at the present time. If turned into sewers it destroys the efficiency of filter-beds; if allowed to pass into streams it causes a state of pollution which gives rise to a nuisance; and if irrigated on land it is liable to pollute the neighbouring wells and to kill vegetation.

(2) Whey contains valuable food materials suitable for human consumption, particularly milk sugar (lactose) lactalbumen, butter fat and mineral salts. Collectively they amount to about 6½ lb. in every 100 lb. of whey.

(3) In this country, while great quantities of lactose are being thrown away in whey, lactose is actually being imported from abroad.

During the year ended 31st March, 1922, satisfactory progress was made with the extraction of crude lactose from the whey received at the factory, and some 15 tons of this crude material were produced.

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Field Drainage Investigations.

THE investigations which have been in progress for some years into the methods and costs of field drainage have now reached an advanced stage, and it should shortly be possible to compile a preliminary report upon the results obtained. In the course of the investigations, two public demonstrations have been given, one at Aubourn Fen, near Lincoln, in November last year, and one at High Hilden, Tonbridge, in October last. By means of these demonstrations the agricultural public have been made acquainted with the wide range of devices which are available for mole and tile drains, for ditch making and cleaning, and for clearing water-ways. The preliminary report will deal with the mechanical and economic questions involved and will afford guidance as to the best and cheapest methods of performing the various operations. The economic aspect of the question is, however, one that cannot be speedily explored, since the efficiency of a drainage system over a series of years is the final test. An outstanding illustration is fur-

nished by the problem whether mole drains of 2½-in. bore at a depth of 18 in. are as efficacious as mole drains of 3½-in. bore at a depth of 2 ft. or more: not only are the rate of flow and the height of the water table in question, but the duration of the smaller, shallower drains as compared with deeper drains of approximately twice the cross section. Successful work has undoubtedly been accomplished with both systems, but no data as to the size of drains, their frequency and depth in given types of soil are available. Such data will need to be collected before a final report can be made, and the collection of information of this character must necessarily take time.

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Sub-Soiling Investigations.

AT the present time many claims are made on behalf of sub-soiling and special virtues are claimed for special systems. As readers of old agricultural periodicals well know similar claims have been made before; an impetus has been given to sub-soiling, mistakes have been made, and the movement has died down. What is remarkable is that no one has hitherto set himself to discover exactly what mechanical results were achieved in the soil and what the effect was on the chemistry of the soil and plant life. The first step clearly is to investigate various types of sub-soiling appliances and to observe the resulting crop. The Ministry has made a commencement with this investigation and a report upon some mechanical results, illustrated by photographs of very considerable interest, will appear in an early issue of the *Journal*.

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The Agricultural Index Number.

THE index numbers of prices of agricultural produce in England and Wales show that, on the whole, average prices during October were rather higher than in September, the increase compared with the corresponding month in the years 1911-13 being 57 per cent. in September and 59 per cent. in October. The following table shows the increase in agricultural prices generally in each month since January, 1921, the corresponding month in 1911-13 being taken as the basis of comparison in each case:—

Month.	*Percentage Increase.* 1921	1922	*Month.*	*Percentage Increase.* 1921	1922
January	183	75	July	112	72
February	167	79	August	131	67
March	150	77	September	116	57
April	149	70	October	86	59
May	119	71	November	79	
June	112	68	December	76	

The index numbers relating to cereals all show slight increases, but prices during October were still only 24 to 33 per cent. higher than in October, 1911-13.

Prices of fat cattle, although showing a slightly hardening tendency throughout October, were less than 50 per cent. above pre-war figures Sheep and pigs also advanced slightly in value during the month, but the average prices over the whole month show very little difference from those of the previous month.

Eggs rose sharply, and as the rise was greater than normally occurs between September and October, the index number also shows a rise, being now more than 100 per cent. above the pre-war figure. It seems fairly certain that egg production is at present one of the most remunerative forms of farming, although it does not bulk largely in the farmers' total receipts. With the exception of geese, which showed a slight advance, poultry was cheaper in October than in September. Both butter and cheese maintained their value, but with the average price in October, 1911-13, showing a substantial advance, the index number for last month shows a decline in each case.

The following table shows the average increase during recent months in the value of the principal commodities sold by the farmer :—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

	May.	June.	July.	Aug.	Sept.	Oct.
Wheat ...	62	60	53	53	23	24
Barley ...	49	58	49	48	26	29
Oats	53	57	55	59	31	33
Fat cattle ...	70	71	70	70	58	49
Fat sheep ...	140	121	107	103	90	90
Fat pigs ...	91	82	91	92	84	85
Dairy cows ...	66	64	64	67	63	69
Store cattle ...	38	40	39	42	33	30
Store sheep ...	100	88	108	114	109	106
Store pigs ...	97	97	115	128	125	135
Eggs ...	50	69	80	64	96	104
Poultry ...	110	116	103	85	85	77
Milk	27	28	53	70	70	90
Butter ...	54	59	79	77	76	71
Cheese ...	48	55	50	51	41	36
Potatoes ...	140	80	75	14	1	3
Hay	33	35	37	54	52	45

The principal cause of the rise in the general index number in October was the increase in the price of milk, which in September was about 70 per cent. above the price in the corresponding month before the War, and in October rose to 90 per cent. above. As dairy cows are purchasable at about 70 per cent., feeding stuffs at less than 50 per cent., and labour at between 80 and

90 per cent. above pre-war prices, the dairy farmers' position would appear to be not unsatisfactory.

The average price of potatoes remained practically unchanged in October compared with September, but as the October price in 1911-13 was rather lower than that for September, the index number shows a slight rise. Hay fell slightly in value, owing principally to the marketing of this season's hay crop; the fall, however, is less than would at first sight appear from the index numbers, as a seasonal advance in prices is usual at this time of the year.

It is evident that in the present agricultural crisis the arable farmer is the greatest sufferer, for combined with his reduced prices he has had to contend with an expensive harvest and poor yields, except in the case of potatoes. Dairying is much more attractive, and the bright outlook for trade in sheep and pigs is reflected in the demand for, and high relative prices of store sheep and swine. Store cattle have been purchasable since the spring of this year at 30 to 40 per cent. above pre-war rates, and with feeding stuffs also obtainable at relatively low prices, even the fattening of cattle would appear to be not unremunerative.

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Corn Sales Act, 1921.

As from 1st January next, when the Corn Sales Act of 1921 comes into force, there should be an end of the varying weights and measures by which corn and agricultural seeds are bought and sold in this country. For many years the different weights recognised in different districts as equivalent to a quarter or bushel of corn and other agricultural produce have been a source of much confusion, and the Act provides for greater uniformity in the weights and measures used in dealings in these articles. As will be seen from the definition section which is set out below the Act applies not only to corn but also to meal, bran, potatoes and agricultural seeds, and after the end of the present year any contract, bargain, sale or dealing in any of the articles to which the Act applies will be null and void unless it is made by weight only and in terms of, or by reference to, the hundredweight of 112 lb. This means that a contract, bargain, sale or dealing which does not conform with the provisions of the Act cannot be enforced in a court of law. It therefore behoves everyone trading in these articles to see that on and from 1st January next, all his

transactions in them are based on a price per hundredweight. There are some exceptions to the Act which are set out in full below, but so far as home-grown crops are concerned, the main exceptions, apart from sales for export, are dealings in growing and unthreshed crops. As regards articles produced outside the United Kingdom, the Act does not apply to dealings in them before they have arrived in the United Kingdom, nor does it apply to imported articles so long as they remain in the warehouse, store or shed where they were first stored on importation. The Act is also not applicable to cases where the contract, sale, etc., provides for delivery in the original bags in which the articles were imported (subject only to rebagging in replacement of damaged bags). So far as the farmer is concerned, therefore, these exceptions as regards imported produce would seldom apply.

The relevant sections of the Act are given below in full:—

Section 1. From and after the commencement of this Act, every contract, bargain, sale or dealing relating to corn shall, unless it is made or had by weight only and in terms of and by reference to the hundredweight of one hundred and twelve imperial standard pounds, be null and void.

Provided that this Act shall not apply to any contract, bargain, sale or dealing—

(i) for or relating to a less quantity of corn than one hundred and twelve imperial standard pounds;

(ii) for or relating to corn which at the date of the contract, bargain, sale or dealing is not within the United Kingdom, or to corn imported into the United Kingdom so long as the same shall remain in the warehouse, or store, or shed where the same shall have been first stored on importation;

(iii) for or relating to corn imported into the United Kingdom in cases where such contract, bargain, sale, or dealing provides for delivery in the original bags in which the corn was imported (subject only to rebagging in replacement of damaged bags);

(iv) for or relating to corn bought or sold for export from the United Kingdom;

(v) for or relating to corn growing on or in the land or to corn unthreshed.

Section 6. In this Act the expression "corn" shall, where the context permits, include wheat, barley, oats, rye, maize and the meal and bran derived therefrom, and any mixture thereof, and this Act shall apply to dried peas, dried beans, linseed and potatoes, and to the seed of grass, clover, vetches, swedes, field turnips, rape, field cabbages, field kale, field kohl-rabi, mangels, beet and sugar-beet, flax, and sainfoin in like manner as it applies to corn.

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HOME-GROWN CORN AND POTATOES FOR LIVE STOCK.

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UNDER normal conditions farmers grow their wheat and barley for sale to the miller and the maltster, and their potatoes for the market. Conditions this year, however, are far from normal, and everyone should consider whether it will pay him best to sell his corn and potatoes or to use them for feeding live stock.

This is a point which it is by no means easy to decide, as so many things must be taken into consideration. It is necessary to know not only the relative food and manurial values and the relative prices of similar feeding stuffs, but the price at which it is possible to buy suitable animals to be fed, and even perhaps in some cases, after two disastrous years, whether it might not ease the situation to sell corn and potatoes for ready cash and to buy even dearer feeding stuffs on credit.

It is impossible to deal here with such economic considerations, which must be decided by each farmer for himself. It is possible, however, to consider the relative feeding value of home-grown and purchased feeding stuffs, and to work out prices at which, other things being equal, it is cheaper to consume corn and potatoes at home than to sell them and to buy other feeding stuffs.

Even this is not quite straightforward, for the comparison should be made, not on price per ton, but on price per unit of nutritive value after making due allowance for manurial value. The best unit of nutritive value to select for this purpose is one hundredth of a ton of what is known as starch equivalent or net digestible energy.

Wheat, barley, oats, and potatoes are all somewhat similar in composition. All of them are characterised by the high proportion of starch which they contain. On the farm they could, therefore, be used to take the place of other feeding stuffs rich in starch, as, for example, middlings and maize. It is with these feeding stuffs that they should be compared.

Feeding Value of Middlings and Maize.—A ton of middlings contains 68 units of starch equivalent. The present price per ton is round about £8 and the manurial value is £1 7s. Deducting the manurial value, the net cost of the 68 units of starch

equivalent is £6 13s. The cost per unit of starch equivalent is therefore £6 13s. divided by 68, or almost exactly 2s. per unit.

The average price of maize at present is round about £2 per quarter, which is equivalent to £9 6s. 8d. per ton. Maize contains 81 units of starch equivalent per ton and its manurial value is 17s. per ton. The net cost of the 81 units of starch equivalent is therefore £8 9s. 8d. The cost per unit of starch equivalent is therefore £8 9s. 8d. divided by 81, or almost exactly 2s.

Starch equivalent costs 2s. per unit in both middlings and maize, the two starchy foods most largely used.

Feeding Value of Home-Grown Corn.—Average samples of sound wheat contain 72 units of starch equivalent per ton. At the present price of starch equivalent in maize and middlings, namely, 2s. per unit, the 72 units in 1 ton of wheat are worth £7 4s. Adding the manurial value of £1 per ton, wheat for home consumption should be worth £8 4s. per ton, or 37s. per quarter of 504 lb. This means that any farmer who owns suitable live stock to consume wheat, and is not in urgent need of ready cash, would be well advised to grind or crush his wheat for home consumption rather than to buy maize or middlings unless he could sell his wheat for considerably more than 37s. per quarter so as to pay for the delivery of the wheat and the carriage of other feeding stuffs bought in its place.

The following table gives the price below which it is more economical to keep corn and potatoes for home consumption rather than to sell them and buy maize or middlings at current prices:—

Wheat ...	37/- per quarter of 504 lb.	plus in each case an addition sufficient to pay for the cost of delivering the articles sold and fetching home the feeding stuffs bought in their place.
Rye ...	37/- „ „ „ 504 lb.	
Barley ...	32/- „ „ „ 448 lb.	
Oats ...	21/- „ „ „ 336 lb.	
Potatoes ...	40/- per ton	

Having arrived at the prices which determine the relative economy of sale or home consumption, the next point is to discuss the use of the various articles in case it is decided to feed them at home.

Wheat.—It is commonly accepted that wheat is not a safe food for horses, and its use is not recommended for sheep. It can, however, be used successfully for pigs and for dairy cows.

For young pigs it may be used up to about one-quarter of their total ration, and it may be given either roughly ground together with the rest of the ration in the dry state, or more finely ground and made into slop.

For fattening hogs wheat may be used up to one-third of their total ration, and in this case it should be fairly finely ground together with the rest of the ration and made into slop.

For milch cows, ground wheat may form as much as one quarter of their total ration of concentrated food. Thus, supposing the ration consists of roots or silage, hay or straw, and 8 lb. of concentrated foods, the concentrated foods may consist of 6 lb. of cake and 2 lb. of ground wheat. In this case the ground wheat is usually mixed with the chaff and pulped roots and allowed to stand some time before feeding. This method of feeding prevents the wheat becoming pasty in the mouth.

Rye on the whole is not of good repute as a feeding stuff in this country. It can, however, be used successfully for pigs in the same way as wheat, provided the ration contains a little fish-meal or dried blood to supply constituents in which the rye is deficient. Skim milk or whey would also provide these absent constituents, or they could be supplied in the form of fresh roots or green-stuff.

Barley is much better known as a feeding stuff for live stock than either wheat or rye; in fact, the annual consumption of barley by live stock in the United Kingdom is not far short of a million tons. It can be used safely and economically for almost all kinds of stock except suckling sows and ewes and milch cows. The general opinion of practical stock keepers is that the use of barley for milking animals of any kind very soon produces a fall in the milk flow.

In the Eastern Counties, where the climate is too hot for the oat crop, barley is the standard horse corn. If used for horses it should be remembered that about 6 lb. of barley contain as much nutritive value as 7 lb. of oats, and in replacing part of the oats in a ration by barley, the replacement should be in these proportions, that is to say, 14 oz. of barley for 1 lb. of oats.

For fattening sheep barley is an excellent food, but when the sheep are on roots, which are poor in protein, the barley should be mixed with some other concentrated feeding stuff rich in that constituent. A series of trials carried out years ago by the Norfolk Chamber of Agriculture showed that by far the best addition to barley is decorticated cotton cake. For three years in succession a mixture of equal weights of crushed barley and decorticated cotton cake produced more mutton at less cost than any other mixture included in the trial.

Barley is also an excellent feeding stuff for pigs, except suckling sows. For fattening hogs it is ground with maize and fed as slop with the addition of a small proportion of bean meal or ground linseed cake or some other feeding stuff rich in protein. A suitable mixture would be equal weights of barley and maize with about one-twentieth to one-tenth of their weight of bean meal or linseed cake.

For younger animals the barley may be crushed and fed dry, and may form nearly the whole of the ration provided the animals have access to roots or greenstuff.

Oats are so well known as a feeding stuff as hardly to need any description of their uses. It may, however, be worth remark that oats are much more valuable for working or milking animals or for stores than for fattening. In case it is found desirable to use oats for pigs, the following method may be found valuable: grind the oats and mix to a thin slop with water; stir well and pour through a coarse sack. The finer, more floury, portions of the grain will run through and the thin slop thus obtained, thickened somewhat with maize meal or barley meal or middlings, may be fed to young pigs or to fattening hogs. The husky portions left in the sack may be used for sows.

Potatoes are a wholesome food for any class of live stock, provided they do not form an excessive proportion of the ration. They can be used either raw or cooked, but only small quantities should be given in the raw state. The common method of using up potatoes which for any reason it is not possible to sell or to use for human consumption, is to cook them for pigs. In this form they can be used to replace part of the meal ration at the rate of 4 lb. of potatoes to 1 lb. of meal.

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WHEN SHOULD THE FARMER SELL HOME-GROWN FOODS?

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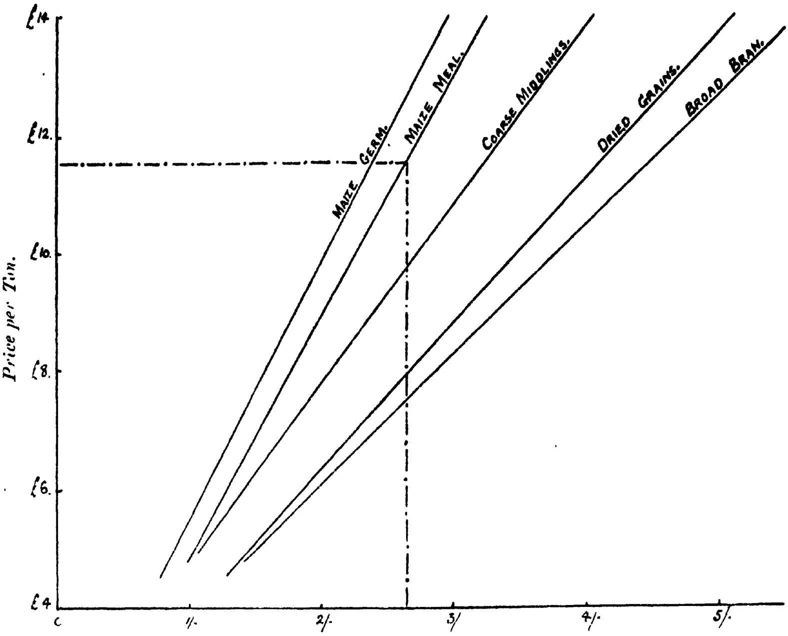
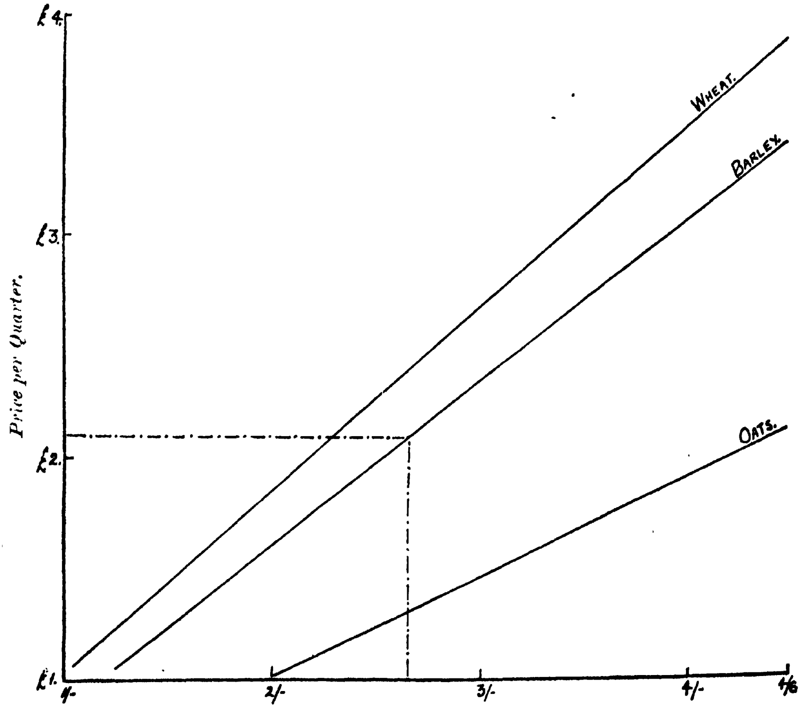
IN the course of the Farm Costings investigations carried on by the University of Leeds it has been observed that there is a growing tendency this year for the farmer to feed his grain to stock, rather than to sell it and purchase cakes and meals. Inquiries are also continually being made as to whether at pre-



Price per Unit Starch Equivalent.
FIG. 1.—Purchased Foods (Carbohydrates).



Price per Unit Starch Equivalent.
FIG. 2.—Home-grown Foods (Carbohydrates.

sent prices home-grown grain is a cheaper food than the usual purchased concentrates and as to what price these home-produced foods must reach before it will pay the producer to sell. A definite answer covering the whole range of purchased foods cannot be given straight away, owing to the large variation in their relative prices at any particular time. The possession of alternative markets is one of the economic advantages of the farming industry, and a study of the question "To Feed or Sell?" has brought out some interesting facts, which are here presented in the hope that they will prove of use to farmers all over the country.

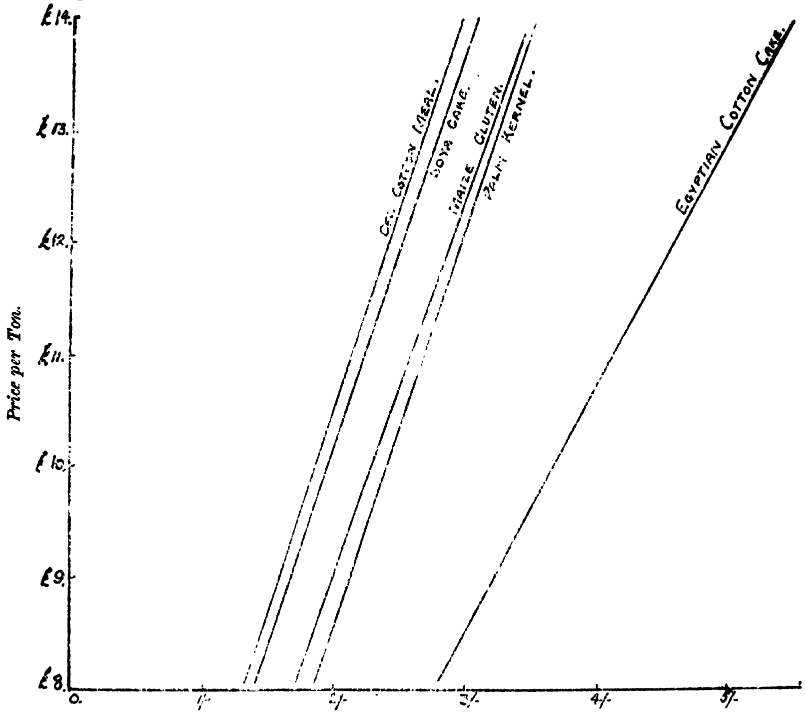
Classification of Foods.—From the chemical point of view, wheat, oats and barley are carbohydrate foods, and can be used to substitute similar types of food normally purchased. No matter which type of carbohydrates is fed—either home-grown or purchased—protein also must be supplied to ensure the greatest possible utilisation of the food. The following list, abstracted from the feeding records of some 50 farms, includes those carbohydrate foods normally purchased: Maize germ meal, maize meal, middlings, dried grains, bran. Which, if any, of these can be replaced by home-grown grains, so as to reduce the cost of a ration?

Basis of Valuation.—As foods—even those in the same class, *e.g.*, carbohydrates—possess different values to the animal, and as they also possess different manurial values, price per ton cannot be taken as a basis of comparison. It is, however, perfectly fair to compare foods of the same class on their price per unit starch equivalent, to determine which is a simple matter.

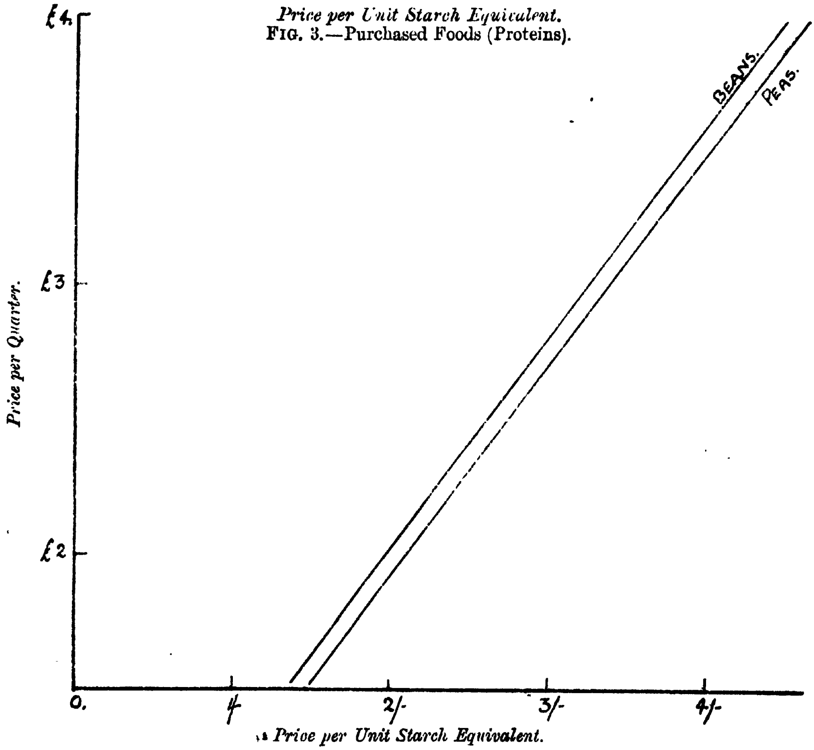
Methods of Calculation.—If from the price per ton the manurial value of the food in question be deducted the result is the feeding value per ton. When this is divided by the starch equivalent of the food—a figure originally proposed by Kellner and now incorporated in most standard tables of the composition of foods—the result is the price per unit starch equivalent. This is shown in the following example :—

Sharps.	(*Starch Equivalent* 63 *per* 100 *lb.*)
Price per ton	£9 10 0
Less Manurial Value	1 14 0
Feeding Value	£7 16 0

Divide feeding value by Starch Equivalent (63)
Price per Unit Starch Equivalent... 2s. 6d.



Price per Unit Starch Equivalent.
FIG. 3.—Purchased Foods (Proteins).



Price per Unit Starch Equivalent.

Simple though this calculation be, it is realised that not all farmers possess the necessary tables—or the time, to work out the unit cost for all the foods they may be offered. To eliminate the arithmetic, the accompanying diagrams have been devised.

To avoid confusion in using the diagrams only five foods are shown in Figs. 1 and 3. Similar curves could, of course, be constructed for any food in which a farmer is particularly interested, the necessary data being obtained from suitable tables.*

Method of Using the Diagrams.—The diagrams show at a glance the price per unit starch equivalent corresponding to any price per ton of a foodstuff, or per quarter of grain. To take a concrete case, a farmer has some barley and considers whether to feed it, or to sell it and buy maize meal for his cows. He is offered 35s. per quarter for his barley and can buy maize meal at £11 per ton. Selling his barley involves carting to a station or mill or elsewhere, so the grain really stands him at less than 35s. on the farm, while against this has to be put the cost of grinding should he feed it. On the other hand, railway carriage and carting would increase the cost of the maize meal, and £11 10s. could be fairly taken as its cost on the farm.

Taking Fig. 1 he looks up the vertical line, until he sees the position corresponding to £11 10s. He then runs his pencil horizontally across to the line marked " Maize Meal," and from the point of intersection draws his pencil vertically downwards to the horizontal line. The point at which this horizontal line is touched represents the price per unit starch equivalent of the maize meal.

He now turns to Fig. 2 and reverses the process. On the horizontal line he finds the point representing the same price per unit starch equivalent as the maize meal would cost. He then moves his pencil vertically until it meets the line marked " Barley," and from there moves horizontally and to the left until until his pencil crosses the vertical line representing " Price per Quarter." If the price offered is less than that indicated by the diagram, it will pay the farmer to feed his barley, but if, on the other hand, the price offered is higher, then he should by all means sell and buy maize meal for his cows.

* (1) Pamphlet No. 73, published by the University of Leeds, which can be obtained free on application to The Department of Agriculture, University, Leeds.
(2) Miscellaneous Publication No. 32, published by the Ministry, price 6*d.*
(3) The table on p. 841 of this *Journal.*
(4) *The Agricultural Market Report*, issued weekly by the Ministry, price 2*d.*

To make this example clearer, the lines which the farmer draws, have been dotted in. They show that maize meal at £11 10s. per ton is costing 2s. 8d. per unit starch equivalent, and that valued on this figure barley is worth as a food £2 2s. per quarter. As, then, the farmer is offered only 35s. per quarter for his barley, it will pay him to feed it, and to continue feeding it until the price offered rises above 42s. per quarter.

It will be found that with a little practice the drawing of lines can be dispensed with, and the whole process will be quickly completed—in much less time than this description takes to read. The diagrams, of course, will hold for any year and any number of examples can be worked from them.

Protein Foods.—Not all farmers grow protein-containing foods in their usual rotations but those who have either peas or beans on hand should consider whether to feed or to sell and buy such protein foods as cotton cake and meal, maize gluten feed, palm kernel or soya bean cake. Figs. 3 and 4 can be used to determine this point, the same method being employed as when comparing the purchased and home-grown foods of a carbohydrate nature in Figs. 1 and 2.

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THE COMPETITIVE EXHIBITS AT THE SECOND IMPERIAL FRUIT SHOW.

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THERE were many at the close of the 1921 Fruit Show who, whilst recognising the advantage gained to the industry by the show, recommended that a lapse of five years should be given before holding a second. They admitted the success of the venture but thought that many had given support because of the novelty of the venture, which support, they feared, would not be forthcoming for a second show if held without an interval. Certainly the holding of a second show under much the same conditions and at the same place (Crystal Palace) was a bold venture; but that it was justified is shown by the number of entries received for competition at the show, which were as follows:—

Apples	1,081	entries.
Pears	107	„
Oranges	15	„
Grapes	15	„
Tomatoes	62	„
Potatoes	486	„
Total	1,766	„

The display of such a large mass of fruit and potatoes was naturally an attractive sight to the many visitors who came to the Palace, and should have some effect in encouraging an increased consumption of fruit by townsfolk. The growers from all parts of England visited the show for another purpose, namely, to see the exhibits in the hope of learning better methods of selecting and packing the fruit for the markets. In this they were not disappointed, for there was much to be learnt by a close study of the methods adopted in selecting the fruit and the methods of packing adopted in the competitive exhibits; useful knowledge on market packages and methods of packing was provided at many of the trade exhibitors' stalls, whilst on the stands of the Ministry the scientific exhibits staged by the Long Ashton, East Malling, Rothamsted, Cambridge and Leeds University Research Stations, together with the models of pests from the Ministry's Pathological Laboratory, afforded a unique opportunity for all to acquire a knowledge of recent research.

The names of the apples were generally attached to each exhibit, so providing information for the less experienced. The Judges' Score Cards were also placed on view, not only that each exhibitor could see the marks awarded to his own exhibit but that all who so desired could study the good and weak points of every exhibit. The writer does not intend to give a general account of the show, for this the technical trade Press has provided, but it may serve a useful purpose to give a few notes on the winning exhibits in the premier classes, commencing with the all-important section where British and Canadian fruits were in competition.

Apples.—*British Empire Section.*—The principal classes in this section were for dessert and culinary apples, and each competitor's exhibit comprised no fewer than 20 boxes. In years favourable to the production of good samples of fruit the selection by a grower of some 4,000 dessert apples or 2,000 cookers, uniform in size, colour and shape, sufficient to fill 20 boxes, is by no means an easy task. This year when British fruit generally was small and of poor colour the task was a hard one, and it would generally be agreed that the British exhibits in this section fell below the high standard achieved in the Kent and Southern Counties and the West Midland Sections, where an exhibit comprised 6 boxes. The Canadian exhibits, though perhaps not so well packed as in 1921, contained good conditioned fruit with plenty of colour and bloom and of uniform size and colour.

In the *dessert* class the Canadian Cox's Orange Pippin, the MacIntosh Red, and Snows competed against the British Cox's Orange Pippin, Worcester Pearmain and Allington Pippin. The first prize was awarded to a good sample of Cox's from Nova Scotia. These apples, which were of medium size and packed 3 × 2 on end, bore a light crimson blush with broken streaks on a bright orange yellow skin, though showing little russet. The flavour, for which it scored full marks, was one of the best. Nova Scotia certainly seems able to produce apples of the best colour and with full flavour.

The second prize went to a fine dessert sample of Snows with clear skin lightly coloured red. Two English samples of Cox's Orange Pippin came next: with the exhibit from Malvern winning by one mark after appeal to the umpire. These exhibits were both excellent, but lacked the colour and brightness of the Nova Scotia apples.

Many other exhibits in this section were excellent, though some were on the small size. Two fine exhibits—Worcesters from Reading and Cox's Orange Pippin from Kent—were disqualified because the exhibitors did not comply with the rules.

For *culinary* apples the Canadians relied mainly on Kings, Greenings and Spy, and the English on Newton Wonders, of which many fine apples were shown, Lane's Prince Albert, and Bramleys. Exhibits of Bismarck and Gascoygne's Scarlet were included. Some bright red Nova Scotia Kings looked attractive and won the first prize. These were very evenly sized and uniformly coloured, but lacked quality. The exhibit of Bismarck from Chelmsford secured the second award, with Newton Wonder —rather on the small size—from Canterbury, third.

There were some very good Bramley's Seedling apples, but this variety does not show to advantage in boxes. Newton Wonder and Lane's Prince Albert on the other hand, looked well in boxes—the bright scarlet flush of the former and the red stripes of the latter showing to advantage. There was one specially fine exhibit of Lane's, which was disqualified by the Judges as the pack did not conform to the rules, being "off-set."

All the winning apples were packed 2 × 2 which may serve as an indication as to the size for future selection of cooking apples.

Pears.—In the Channel Islands and the Great Britain sections there were many different varieties of pears, of which Doyenné du Comice, Conférence, Durondeau, Calebash, Louise Bonne, Marie Louise, Emile D'Heyst, Pitmaston

Duchess and Catillac were the more prominent. In some exhibits the pears were packed either in cotton or wood wool; in others they were wrapped in paper and packed in boxes in a manner similar to that adopted for apples. Where care in packing had been given both methods proved satisfactory, though generally the packing of pears was at fault and contrasts of the packing provided an excellent object lesson to those willing to learn by observation.

The Conférence section was strongly contested, but the standard was low as would be expected for Conférence at this late date.

In the Great Britain section there was one exhibit from Sussex of exceptionally large, fine quality Doyenné du Comice, which lost the first prize solely through bad packing. The first prize was awarded to an exhibit from Kent of much smaller pears, of even size and colour and excellently packed. Generally this class was but slightly contested. The standard of fruit was high, but the packing poor. Much of the fruit rapidly deteriorated owing to bruising due to faulty packing, and prices by auction ruled low. The Doyenné du Comice in the Channel Islands section were on the whole better than in the Great Britain section. The fruits were larger, in better condition, and the best exhibits were carefully packed, the fruit being separated with protective paper. In many of the exhibits in this section the fruits were tumbled together instead of being nicely separated and kept in position by paper partitions. The Channel Islands fruit kept well and the well packed fruit realised quite good prices at the sale.

Pitmaston Duchess figured largely in the " any other dessert variety " class in both the Great Britain and the Channel Islands sections, and some excellent, large bright specimens were shown. The exhibits of Calebash and Durondeau were rough, the Louise Bonne small, attractive and nicely packed.

In the class for cooking pears, Catillac was shown in every instance except one, and this won the first prize. The second prize was awarded to an excellent and nicely coloured sample of Catillac from Faversham. The other samples of Catillac lacked uniformity and it was evident quality had been sacrificed to large size.

Grapes.—There were classes for grapes in the British Empire section, the Great Britain section and the Channel Islands section, but only in the last were there any material entries. Generally Muscat of Alexandria was shown in the classes for white grapes and Colmar as blacks. All exhibits were good, the

bunches were of large size and contained good even sized berries in excellent condition and full of bloom.

The bunches of grapes were tied to shallow baskets which were lined with white paper, wood, or cotton wool, depending on the method adopted. The grapes in every single instance when packed in this way had travelled well, retaining most of the natural bloom and freshness, and were generally admired by the public.

It was difficult to decide as to the best exhibit in the show; some of the public preferred the waving exhibit of Colmar shown by Mr. Tostevin, Guernsey, in the Channel Islands section; while others thought the Colmars of Messrs. Douglas Brothers, of Worthing, which secured the first prize in the Great Britain section, superior. Both were good and at the auction sale each realised 12s. per basket.

The Dominion of Canada has cause to be proud of its successes attained at the present show, and the State of Nova Scotia by securing the two first prizes has abundantly demonstrated the capabilities of that State for producing apples of the highest class. In the Section confined to Overseas eleven of the possible fourteen first prizes were secured by Ontario, which must rank as a great performance. Channel Island exhibitors were showing for the first time and they have every reason to be satisfied with the produce shown and the success achieved

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ELECTRO-CULTURE.

ALTHOUGH investigations into the influence of electrical discharge on plant growth are still in the preliminary stages and the economic possibilities of "electro-culture" are still uncertain, so much interest has been manifested in the subject that it is desirable to give a brief account of the work so far accomplished under the direction of the Electro-Culture Committee.*

* The Committee was appointed in 1918, to "advise the Ministry of Agriculture and Fisheries in regard to all electrical questions in connection with the carrying out of experiments in electro-culture, and particularly in regard to the construction of apparatus suitable for use on an economic scale, and to the making of such electrical measurements as may be necessary in connection with the experiments." The present constitution of the Committee is as follows:—Sir John Snell, M.Inst.C.E. (Chairman); Mr. A. F. Berry; Professor V. H. Blackman, F.R.S.; Mr. A. B. Bruce, M.A.; Dr. C. Chree, F.R.S.; Mr. W. R. Cooper, M.A., B.Sc., A.I.C.; Dr. W. H. Eccles, F.R.S., M.I.E.E.; Mr. P. Hedworth Foulkes, B.Sc.; Mr. J. S. Highfield, M.I.E.E.; Professor G. W. O. Howe; Professor T. Mather, F.R.S., M.I.E.E.; Mr. B. J. Owen, M.Sc., M.Eng.; Mr. H. G. Richardson, M.A., B.Sc.; Sir John Russell, F.R.S.; and Mr. C. T. R. Wilson, F.R.S.

The scientific aspect of the work will be more fully dealt with in two papers which Prof. V. H. Blackman is contributing to the "Journal of Agricultural Science." The Committee has now been at work for five years and has issued four interim reports*: the work completed in 1922 which was undertaken on lines suggested by the experience of previous years promises very striking results, but an account of that work must await the fifth interim report of the Committee which has not yet been presented.

In view of the complexity of the subject the Committee have confined their experiments to electro-culture by means of overhead discharge. Field experiments have been carried out for the Committee by Professor V. H. Blackman at Rothamsted with barley (1918 and 1920), winter sown wheat (1919 and 1920), winter oats (1921) and clover hay (1919, 1920 and 1921); at Lincluden (Dumfries) with oats (1918, 1919 and 1920), and potatoes (1921); and at Harper Adams Agricultural College with oats (1919, 1920 and 1921), clover hay (1920) and pea and oat mixtures (1921). Pot-culture experiments have been carried out by Professor Blackman at Rothamsted in 1918. 1919, 1920 and 1921, with wheat. maize and barley; laboratory experiments to determine the effect of electric currents on the growth of plant organs have also been undertaken.

Field Trials.—*Apparatus.*—The apparatus at Lincluden consisted of a mercury interrupter, supplied with a direct current at a voltage of 60, an induction coil and three Lodge valves in series. At Rothamsted it consisted of a petrol-driven "Delco" set, with at first a dry transformer and later an oil-cooled transformer. and a Newton and Wright disc-rectifier. At the Harper Adams Agricultural College current (100 volts D.C.) was available from the small electric lighting installation of the College. The apparatus consisted of a 2-h.p. motor coupled to a one K.V.A. A.C. generator (140 volts) which bore on an extension of its spindle a Newton and Wright disc-rectifier. An oil-cooled transformer (1-K.V.A.) giving a voltage up to 60,000 was employed for the discharge current.

Field Installation.—A steel cable supported on high tension insulators was fixed at a height of about 7 ft. at each side of the electrified areas and fine galvanised steel wires (gauge 29) spanned the distance between the cables. The wires were 5 or 10 ft. apart. The aerial installation was made positive.

* To be obtained free on application to the Secretary to the Committee, Mr. W. R. Black, B.Sc., Ministry of Agriculture, 10, Whitehall Place, S.W. 1.

At Harper Adams Agricultural College a screen of wire-netting, 8 ft. high was fixed between the electrified area and the control area during one season's experiments.

Current.—The currents varied at the different stations with different crops, and in the different years. Those in 1921 were as follows:—At Lincluden, the discharge was given at the rate of about 0.5 milliamp. per acre; the voltage (crest value) was about 25,000. At Rothamsted two installations were supplied from the same transformer, so that the current could be controlled in one only, that over winter oats being selected. With this crop the voltage (crest value) varied between 25,000 and 55,000 and the total discharge current was maintained at the rate of 0.5 milliamp. per acre. The discharge given to the clover grass varied from 0.2 milliamp. to 0.6 milliamp. per acre. At Harper Adams Agricultural College also two installations were supplied from the same transformer. With oats the voltage (crest value) varied from 25,000 to 56,000, and the current was kept at about 1.0 milliamp. With the pea and oat mixture the current varied between 0.25 and 1.25 milliamp. per acre.

Period of Discharge.—The periods during which crops were subjected to the overhead discharge varied from 500 to about 900 hours. As a rule the period lasted from April to August and the discharge was continued for 6 or 8 hours daily.

Results of Field Experiments.—The results from different crops in different years and at different stations are fully discussed in the four Interim Reports which should be consulted for details. The accompanying table, however, gives a general summary of results of field experiments from 1915 onwards (those from 1918 being under the auspices of the Committee). This summary does not include results obtained in 1921, the dry weather of that year being unfavourable for field experimental work.

The data taken as a whole show that of the fourteen *positive* results of experiments extending over six years only three are less than 10 per cent., while of the four *negative* results none reaches 10 per cent. Of the ten positive results with spring-sown cereals only two are less than 10 per cent., and six show an increase of 30 per cent. or over; while of the two negative results both show decreases of less than 10 per cent. The results of field experiments with these spring crops show an average increase of 22 per cent. The effect of electrification in increasing the yield of spring-sown oats and barley has thus

been demonstrated. A beneficial effect on clover-hay is probable, while that on winter-sown wheat is still uncertain.

SPRING SOWN CEREALS.

			Difference in Yield per acre of Electrified Crops compared with Control Crops. Actual. Bush.	Relative. per cent.
Lincluden	1915	Oats	+ 4·8	+30
"	1916	"	+ 11·2	+49
"	1917	"	+ 0·7	+ 2
"	1918	"	+26·7	+50
"	1919	"	+12·8	+35
"	1920	"	— 2·6	— 6
"	1920	"	+18·8	+57
Rothamsted	1917	Barley (Small plots)	(+2·5)*	(+35)
"	1918	"	+ 4·4	+10
"	1920	"	+ 5·1	+19
Harper Adams College	1919	Oats	+ 1·0	+ 2
" "	1920	"	— 4·3	— 9
		Mean	+ 7·1	+22

WINTER SOWN WHEAT.

			Bush.	per cent.
Rothamsted	1919		+ 6·0	+38
"	1920		— 0·7	— 4

CLOVER-HAY.

			Cwt.	per cent.
Rothamsted	1919	(1st Crop)	+11·7	+50
"	1919	(2nd Crop)	+ 4·3	+34
"	1920		+ 0·5	+ 2
Harper Adams College	1920		— 3·0	— 6
		Mean	+ 3·4	+20

Pot Culture Experiments.—The object of these experiments carried out at the Rothamsted Experimental Station has been to obtain various data as to the current to be used in electro-culture work on the early vegetative growth of cereals. The subjects investigated have been strength of current, the relative effects of direct and alternating current, and of upward and downward current and the period of the life of the grow-

* One result, that of the Rothamsted experiment of 1919 with wheat, has been excluded, for owing to special conditions the crop was a partial failure, yielding only 8 bushels to the acre. The decrease in yield of the electrified area as compared with the control was 7 per cent.

Also in calculating the differences in yield between the two areas, that of the Rothamsted barley plots of 1917 has not been included in determining the average, for the crop was harvested some time before maturity.

ing crop when the discharge is most effective. Wire networks charged to a high voltage (4,000-16,000 crest value) were suspended at various heights above the plants; the current passing through plants was led off from the bottom of the insulated pots to a micro-ammeter reading to 0.01 microamp. The networks were made positive, except for one set of experiments in 1921. The control pots were " earthed " in all cases.

In 1918 and 1919 the high tension discharge was obtained by the use of a mercury interrupter and an induction coil, Lodge valves being employed for rectification. In the experiments of 1920 and 1921 the installation consisted of a small rotary converter giving 70 volts A.C., and a wax-impregnated transformer made by Messrs. Newton and Wright.. The overhead networks, when alternating current was used, were connected directly to the transformer: when direct current was required rectification was obtained by means of Lodge valves. The plants themselves were able to bring about some slight rectification.

The discharge in these pot experiments was usually given for about six hours each day. There were two experiments with wheat, nine with maize, and nine with barley.

In 1918 it was found that (under the conditions of the experiments) currents passing through the plants of the order 10×10^{-9} amp. were injurious in the case of the early vegetative stages of maize. Currents as low as 0.3×10^{-9} amps. appear to have an accelerating action on growth. The experiments of 1920 suggested that alternating current is as effective as direct current, if not more effective; the results obtained that year with direct current were, however, less satisfactory than in previous years.

The experiments of 1921 confirmed the results of 1920 that alternating current is usually as effective as, or more effective than, direct current. They further suggested that an upward current through the plant can increase growth in the same way as a downward current; and, lastly, they suggest that a discharge applied for the first month only of the growing season may be at least as effective as one continued throughout the growing season—a result, if confirmed, of great importance since it shows that the running costs of crop electrification can be markedly reduced.

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IMPROVEMENT OF MOORLAND GRAZING IN THE NORTH OF ENGLAND.*

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THE total area of land in Northumberland is over 1¼ million acres. Of this about 700,000 acres are under crops and grass, and there are about 500,000 acres of moorland pasture and rough mountain land in the county. The object of this article is to deal with the portions of the latter that are capable of economic improvement. Experiments on the improvement of moorland have been conducted for some years on several moorland farms, in the upper North Tyne, including Kielder (Mr. Thornton), Newton (Mr. John Robson), and at other centres. The results have been most suggestive, and indicate possible lines of improvement.

Trials near Bellingham, 1920.—In the autumn of 1919, Mr. Arthur H. Ridley, Park End, Wark-on-Tyne, offered to have an area of about 14½ acres of moorland at Highfield farm, about 5 miles north of Tarset Station, fenced off and treated with a suitable manure. This area is at about 800 ft. altitude. Part of it was under cultivation many years ago, while the remainder is virgin moorland and is typical of very large areas of such. It includes some dry moorland with a little heather and also land on which are growing rough grass and moorland plants.

Basic slag (38 per cent. phosphates) was applied at the rate of 10 cwt. per acre on most of this area in the early spring of 1920. A portion of the enclosure was left untreated, and to the north a portion of the unenclosed moor was treated with basic slag at the same rate per acre. Mr. Ridley has met the greater part of the cost (over £100) of this trial. The carting of the material and the application of the slag were done by the tenant.

When inspected in August, 1922, it was found that the part to the south-east, which was in cultivation many years ago, is not yet responding well to basic slag. The tops of the ridges have no clover plants, very wiry grass, and a good deal of dead organic matter on the surface, underneath which the soil is very dry. In the furrows, where there is more moisture, wild white clover is developing well and is slowly extending towards the

* See this *Journal*, January, 1921, p. 928.

crowns of the ridges. It is probable that a good effect would be produced by cuts with a disc harrow or by other means, made on the crowns and in the direction of the ridges, so as to allow rain water to penetrate to the soil. Grazing with cattle is being done and will help this tendency. The best clover development is on virgin moorland on the northern part of the enclosure, where the soil is near the surface and there is not much matty covering. Between the rushes in these parts clover plants are developing well. and this is also taking place immediately to the north on the unenclosed moor. Cattle are eating the herbage much better in the enclosed area than sheep are doing on the moor outside. On the west of the area the moorland is dry and harsh and here there is little result. It is evident, therefore, that this latter is not the kind of moorland on which improvement should be attempted.

The important lesson already derived is that there are only limited areas of moorland which can be profitably improved by basic slag or other phosphatic manures, and that the areas that can be so improved are those on which small clover plants can be found and where the soil is fairly near the surface. Soil of a loamy or heavier character is likely to respond to phosphatic manuring, but sandy moorland will probably not do so to anything like the same extent. Evidently a damp condition of the moor is a distinct advantage, provided the land is not waterlogged with stagnant (marshy) water. Where there is much dead organic matter on the surface the phosphatic manures cannot reach the soil underneath for many years, and there is little hope of improvement for a long time. Clover plants are usually absent on such areas.

Trials near Haltwhistle, 1920.—Alderman Sample has made similar trials at Whiteside, 4 miles north of Haltwhistle, at an altitude of about 700 ft. High grade basic slag (10 cwt. per acre) and mineral phosphates in equivalent quantities, applied in the winter of 1920-21, are already showing good results on moorland where the conditions are favourable, as at Highfield, but there is practically no response to these manures where the herbage is harsh and coarse in character, with no clover plants and a thick mat of organic matter.

The results were of the same character on Tipalt moor, adjoining Whiteside (Mr. Edward Joicey, Blenkinsop Hall, Haltwhistle); on the Paise farm, 4½ miles from Hexham (the late Mr. R. O. Blayney), and at Westburnhope farm, 9 miles south of Hexham (Mr. Edward Robson).

Grazing with Sheep and Cattle.—On moorland farms, grazing with cattle helps greatly in improving the herbage, as cattle eat far more of the stemmy herbage than sheep. At Cockle Park, where pasture of the poorest character has been effectively improved by basic slag, grazing with sheep alone gives gains of about 100 lb. live weight per acre during each grazing season, whereas when the plots are stocked with cattle and sheep about double this live weight increase is obtained. The plots grazed with sheep alone develop much stemmy herbage and clover development is checked, whereas grazing with cattle and sheep gives pasture with little stemmy herbage and a close and firm bottom of grass and clover plants.

Trials in Scotland.—Dr. Shirra Gibb, in 1906, reported on trials of basic slag, kainit and lime on hill grazings at twenty centres in Scotland.* The dressings per acre were, 5 cwt. slag, 10 cwt. ground lime, and 2½ cwt. kainit. The slag and lime were applied on half acre plots and the kainit was applied as a cross dressing.

The conclusions drawn were that basic slag may be expected to do good on clay soils, with clay or tilly subsoils, which have small clover plants and poorly eaten grasses, and that in such cases kainit was not required. On moory, mossy and generally black topped land slag was evidently helpful, with probably in this case the addition of kainit. If the sod was very dense and the roots thick and matted it was doubtful if any manuring would pay.

Ploughing out Matty Turf.—Much of the old grass land ploughed out during the last years of the War had a thick matty covering on the surface. This covering is a common cause of poverty in moorland hay and grazing land and has been encouraged by grazing with sheep alone, or by continually mowing for hay, usually late in the autumn. The application of nitrogenous manures like sulphate of ammonia and nitrate of soda has tended to develop this matty covering, as such manures encourage the wiry grasses and check clover plants. On the Palace Leas meadow hay field at Cockle Park, sulphate of ammonia, applied continuously for over twenty years, has developed such a mat to a depth of over 3 in. of the same character as is to be found on much of our moorlands, whereas where basic slag alone has been regularly applied no such mat has been formed and the soil is close to the surface. In the former case the aftermath is of a harsh and wiry character which the grazing stock refuse to

* *Transactions of the Highland and Agricultural Society*, 1906, p. 80.

eat, thus leaving the wiry herbage to accumulate on the surface for years.

Where old grass land with a mat of this character has been ploughed out and, after one or two corn crops, or being put through a rotation, has been judiciously sown down with the right seeds mixture containing wild white clover, and treated with basic slag or other phosphatic manure, young pastures have resulted of a far greater value than the poor benty pasture which was ploughed out.

At three centres at least in Northumberland some moorland is now being ploughed out, the object being to bury matted turf and to bring soil to the surface. It is recommended that such ploughing be done early in the winter, with a disc coulter, to bury the turf as effectively as possible. Harrowing should be well done in spring with a disc harrow if possible. High grade basic slag at the rate of 10 cwt. per acre, or finely ground North African phosphates at the rate of $6\frac{1}{3}$ cwt. per acre* should be harrowed in, as well as sulphate of ammonia. $\frac{3}{4}$ cwt. per acre, to assist the oat crop. Old fashioned tillering oats, as the Sandy variety, may be sown at about 3 bushels an acre. A suitable seeds mixture should be sown immediately after. For this purpose the following seeds mixture per acre is suggested:—18 lb. perennial ryegrass, 8 lb. cocksfoot grass. 3 lb. red clover (preferably late flowering) and 1 lb. wild white clover. Care must be taken to get a firm seed bed with a good tilth on the surface. The oats should be mown green and made into hay, unless they promise to mature in good time. Success in this direction would provide on moorland farms hay and pasture of a most valuable character.

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* For particulars of these manures see this *Journal* for Sept., 1922, p. 519; Oct., 1922, p. 600; and Nov., 1922, p. 706.

LABOUR ON THE FARM.

II.

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and J. S. SIMPSON, B.Sc.,
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[*The first part of this article in the November issue of the* JOURNAL *dealt with the influence of the War on the labour bill.*]

A REVIEW of the labour bill per acre on the farms of which the accounts were available, showed such large variations that an attempt was made to analyse the factors responsible for the variations.

Size of Farm.—The farms were grouped according to size and the average labour bill per acre was calculated, in an attempt to see if size of farm was a determining factor in the labour bill. Table V illustrates the results obtained.

TABLE V.—VARIATION OF LABOUR BILL WITH SIZE OF FARM.

Size of Farm, acres.	*No. of Farms.*	*No. of Acres comprised.*	*Labour Bill per acre, 1921–1922.* £ s. d.
0–50	3	96	10 4 10
50–100	4	300	3 12 11
100–150	4	504	3 17 11
150–200	5	863	3 0 0
200–250	3	642	4 0 2
250–300	3	784	1 17 7
Over 300	7	2,526	3 19 1

As was expected the labour bill per acre on holdings of less than 50 acres was much greater than that on larger farms. On the basis of size alone it is impossible to correlate the remaining figures, and consequently the influence of a second factor—the proportion of the farm under grass—was investigated.

Proportion of Grass.—The figures obtained are tabulated in Table VI.

TABLE VI.—VARIATION OF LABOUR BILL WITH PROPORTION OF GRASS.

Percentage of Farm under Grass.	*No. of Farms.*	*Acres Comprised.*	*Labour Bill per acre.* £ s. d.	*Group.*
0–20	2	336	6 3 5	1
21–40	8	1,545	3 0 7	2
41–60	7	1,754	4 2 3	3
61–80	5	1,110	2 12 4	4
81–100	4	608	3 19 0	5

The group of farms with the lowest proportion of grass land has the highest labour bill per acre. This was to be expected, but the reduction of 50 per cent. in the labour bill which occurs in the next group, was not anticipated. When the figures for the other groups, with a still higher proportion of grass land, are examined, it will be realised that the proportion of grass, although influencing the labour bill, is not by any means the only factor. The character of the farming undertaken on the farms in the last two groups supplied the reason for the labour bill figures. The farms in the last group are all grass land dairy farms where large milking herds are kept and milk is produced on highly intensive lines. Consequently the labour bill on these farms is high. The fourth group, on the other hand, is composed almost entirely of farms where either summer grazing of bullocks or the breeding of sheep is the main branch followed, and as the labour requirements of these classes of stock are small, the labour bill per acre is correspondingly low.

It would appear, therefore, that the amount of the labour bill on any particular farm, provided the labour is organised to the best advantage, is determined by the interaction of at least three factors :—

1. The size of the farm.
2. The proportion of the land under grass.
3. The system of farming adopted.

Of these, the third is probably the most important.

System of Farming Adopted.—On most of the farms which have been costed labour and time sheets have been kept from which it has been found possible to extract each year the number of days of manual, horse or tractor labour employed per acre of each individual crop, or field, or per head of each variety of stock. In Table VII are given the average results obtained on all farms costed from 1918 to 1922, while, for the sake of comparison the figures quoted by Bridges as obtained from an East Midlands farm in 1918 are also given.*

When it is remembered that the figures quoted by Bridges for the grain and pulse crops are exclusive of the necessary work for threshing and delivering, that on this East Midland farm of 965 acres a large amount of steam cultivation, with its accompanying comparatively small amount of manual labour, was carried out on much of the wheat, oats and barley, and that such operations as hedging, fencing, draining, ditching, road

* See this *Journal*, July, 1922, "Labour Organisation on an East Midlands Farm, by Archibald Bridges."

repairs, which we have allocated to the various crops, have in the other case been included in the overhead or establishment charges, it will be seen that the agreement between figures found for one year on one farm and those found on an average of approximately 20 farms for 4 years is closer than might have been expected. The big outstanding differences appear to be those found in the cases of the swedes and pasture.

Swedes on the East Midlands farm would probably have mostly been fed off by sheep, thus eliminating the cost of lifting, while in the case of the pasture the labour involved in the so-called establishment charges, which we have found to average from three-quarters to one day per acre, would readily account for the difference.

TABLE VII.—DISTRIBUTION OF MANUAL LABOUR.

	Number of Days per acre.	
	Average of all Farms Costed, 1918–22.	*East Midlands Farm*, 1918.*
Roots:—		
Carrots	56·0	61·4
Potatoes	34·1	33·8
Mangolds	23·7	16·7
Swedes	23·0	8·3
Soft Turnips	21·2	—
Rape and Kale	10·6	—
Cabbage	22·2	—
Cereals:—		
Wheat	8·7	4·3
Oats	8·0	4·3
Barley	7·7	4·6
Peas	10·6	7·7
Beans	8·2	4·0
Linseed	9·4	—
Seeds:—		
Mown	3·1	2·2
Grazed	1·3	0·7
Meadow Hay	2·5	2·1
Forage Crops	6·1	0·0
Pasture	0·9	0·1

	Number of Days per head of Stock.
	Average of all Farms Costed, 1918–22.
Cows	24·5
Other Cattle	6·7
Pigs	2·8
Sheep	0·9

* This *Journal*, Vol. XXIX, No. 5, p. 450.

While the average figures only, as found by us, have been quoted, yet from farm to farm, and even from year to year, the amount of manual labour employed on any particular crop has been found to vary considerably with the season, the type of soil and the capability of the farmer as a manager. It is, however, quite evident that on an arable farm the man who concentrates on potatoes, carrots and possibly peas, will have a higher labour bill than one who concentrates on cereals; and the man who attempts to supply succulent food to his stock in the form of forage crops should have an advantage as far as labour bills are concerned over one who supplies it in the form of roots. On farm R.T.T., consisting of 304 acres of light land, 89 per cent. of which is arable, and on which 41 acres of potatoes, 10 acres of carrots and 15 acres of peas were grown last year, the labour bill amounted to £5 8s. 7d. per acre, as compared with £2 17s. 7d. on farm A.T.J., a farm with approximately the same proportion of arable land the texture of which rendered it typically wheat land.

On farms which may be looked upon as "grass land farms," the labour bill per acre is bound to vary according to the kind of stock that the grass land is carrying.

Thus on farm P.O.H. the wages bill amounted last year to £6 18s. per acre. Here 90 per cent. of the land is grass, but milk production on the intensive system is carried on.

On farm E.P.M., engaged in the breeding, rearing and fattening of cattle, the labour bill amounted to £2 9s. 9d. per acre, and on W.S.S.. a similar farm, to £2 19s. 5d.

On farm W.J.C., a Dales farm of 321 acres, 76 per cent. of which is grass, though not altogether a sheep farm, yet one on which the farmer specialises in sheep, the labour bill amounted only to £1 10s. 9d. per acre.

Justification of Labour Bill.—If one were asked, "what labour bill per acre is a farmer justified in having at the present time?" no definite answer could be given. The labour bill on every farm must be justified by results.

The labour bill during the year 1921-1922 on 26 Yorkshire farms of 5,285 acres has been examined, and was found to vary from about £1 8s. to £18, with an average of about £3 12s. 6d. per acre.

If we judge by "labour bill" alone, it would appear that certainly the figures regarding the first 7, and probably those of the first 12 farms were too high, and that the last 5 and possibly the last 11 farms were not paying sufficiently high wages.

Farms, however, are not run on philanthropic lines, and the final decision as to what each individual farmer is justified in paying as wages to his men will be decided by what his men are enabled to do for him.

In other words the wages bill on each farm will finally be justified by the " gross income " or better still the " net output " which the labour employed on the farm obtained.

When we put the actual labour bill per acre against the income received for every pound spent in labour, or the net output obtained from the farm for every £5 spent in labour, we can readily judge whether the labour bill on any particular farm was justified or not, and can certainly form an opinion as to the efficiency of its labour organisation. On the average last year on the whole of the 26 farms the gross income was roughly four and a half times the labour bill, and for every £5 spent in labour, the average net output amounted to £6 5s.; in other words last year labour took approximately 80 per cent. of the output.

In the case of farm H.W.C. the labour bill was decidedly high, though not so unreasonably high as might at first have been imagined. The gross income from this holding amounted to £63 per acre. Had the labour bill borne the ratio to the gross income that has been found to obtain on the 26 farms quoted, either the gross income should have amounted to £80 per acre instead of £63, or the income actually obtained would have justified an expenditure not of £18, but of just under £14 per acre. The net output from this holding amounted to £21 8s. per acre, which should have sufficed to satisfy the reasonable demands of farmer, labour and landlord. As the land was rented at £3 5s. per acre, and as the labour bill absorbed just over £18, it will be seen that little more than half-a-crown per acre would be left as profit for the farmer. If we distribute this net output, not according to what might be looked upon as a fair proportion for each claimant to take, but according to the average proportion actually determined last year, it will be found that of a net output of £21 8s. per acre, labour might have been expected last year to claim £17 5s. instead of over £18 as actually received. The labour bill on this farm may therefore be considered as approximately £4 5s. per acre too high when judged by the gross income obtained from the farm, and about 15s. per acre too high when judged by the net output.

On farm R.S.F., a small holding of 32 acres where the labour bill amounted to £13 3s. 8d. per acre, the gross income to £43 12s. 4d. and the net output to £8 18s. 10d. per acre, the

labour bill was again too high from whatever standpoint we view it. Judged by the wages actually paid on other farms, it was approximately £9 10s. per acre too high; taking into account the high gross income obtained from the holding it is still more than £4 per acre too high; and when, finally, judged by net output, it is at least £6 too high. One would certainly be standing on safe ground in pointing out to the management that the labour bill on that particular farm must be kept within the limits of £8 per acre, if it is to be run as a commercial success.

On farm P.O.H., 120 acres, the labour bill amounted last year to £6 18s. per acre, the gross income to £57 9s. 10d., and the net output to £22 6s. 1d. per acre. The labour bill per acre was approximately double what has been found to obtain on all the farms costed, yet in this case labour was not taking more than its fair share. On the basis of the gross income, the farmer was paying £5 per acre, and on the basis of the net output nearly £11 per acre *less* than the average so paid on the other farms. The labour bill here was high, but amply justified; every penny was well spent, and all the money well earned.

On farm C.M.F. the labour bill was £6 4s. 10d. per acre, the gross income £11 18s., and the net output less than £1 per acre. Here the labour bill was undoubtedly high, and there was nothing in either the gross or net returns to justify the high wages so paid. Whether this was the fault of the labour engaged or of the management concerned could easily be shown by further investigation of the accounts. On the basis of the gross income obtained, there was apparently justification for an expenditure only of £3 per acre instead of over £6, while had labour been content with 80 per cent. of the net output, the proportion in the average figures, it could only have laid claim to approximately 15s. per acre.

On farm M.A.H., the labour bill amounted only to £2 12s. per acre. Even this low figure was too high if we were judging by results, for the gross income amounted only to £6 6s. 9d. and the net output to £0 14s. 9d. per acre. Of the gross income, labour took 41 per cent., as compared with an average last year of 23 per cent. on the other farms; and an amount equal to 349 per cent. of the net output as compared with an average of 80 per cent.

On the other hand labour bills on farms H.N.O. and W.A.R., and possibly on J.H.S., might with advantage have been increased, and it would most probably have paid the farmers in these cases to have made such an increase.

	Labour Bill, per acre, actually paid. £ s. d.		Gross Income, per acre. £ s. d.		Net Output, per acre. £ s. d.
H.N.O. ...	1 8 6	...	17 19 1	...	4 2 1
W.A.R. ...	1 16 3	...	9 18 9	...	5 2 1
J.H.S.	1 19 8	...	9 12 8	...	3 18 0

Had labour on these farms been paid on results at average rates comparable to those paid on the whole of the farms, one would have felt that on H.N.O. a labour bill of approximately £3 15s., on W.A.R. of approximately £3 7s. 6d., and on J.H.S. of approximately £2 17s. 6d., could not have been considered too high.

Conclusions.—In our opinion the following conclusions may be drawn from this examination of farm accounts in Yorkshire :—

a. From the outbreak of the War up to the year 1918 labour was not getting its fair share of the increased prosperity of the farms.

b. It was not until January, 1920, that the increase in wages on the farm had actually risen in proportion to the increase of the cost of living.

c. At the time of the abolition of the Agricultural Wages Board the percentage increase in farm wages was approximately 20 points above the percentage increase in the cost of living, and in April, 1922, at least 45 points above.

d. If the claim be admitted that labour is entitled to a wage proportionate to the increased cost of living, on present rates it would not be until April, 1923, that the surplus it has obtained since January, 1920, would counterbalance the deficit from the outbreak of the War up to January, 1920.

e. The maximum percentage increase in farm wages since the outbreak of the War has agreed very closely with that which has obtained in other industries.

f. The percentage increase in the farm wages which were being paid in April, 1922, was apparently higher than in many other industries.

g. During the year 1919-20 labour took on the average 49 per cent., during 1920-21 78 per cent., and during 1921-22 84 per cent. of the net output.

h. During the last two years it has been getting more than the industry could reasonably be expected to grant.

i. On any well managed farm the labour bill will be determined by (1) the size of the farm, (2) the proportion of the land under grass, and (3) the system of farming adopted.

j. The manual labour required for carrots will be approximately $5\frac{1}{2}$ times, for potatoes $3\frac{1}{2}$ times, and for roots $2\frac{1}{2}$ times as great as that required for corn crops; for seeds hay it will be approximately $\frac{1}{3}$, for meadow hay $\frac{1}{4}$, and for pasture $\frac{1}{8}$ of that required for a corn crop.

k. The manual labour required in attention to a cow is 4 times that required in attention to a bullock, 8 times that required in attention to a pig, 24 times that required in attention to a sheep.

l. For the year ending 31st March, 1922, the average labour bill amounted to approximately £3 15s. per acre, but varied considerably on different farms. Last year it should not have been more than a quarter of the gross income, while on the best managed farms it rarely exceeded one-fifth of the gross income. Even last year, it should not have exceeded 30 per cent. of the net output, and, if the share which the farmer is to receive is again to become a reasonable one, it should not greatly exceed 40 per cent. of the net output.

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COUNCIL OF AGRICULTURE FOR WALES:

THE AGRICULTURAL POLICY RECOMMENDED BY THE COUNCIL.

A SPECIAL meeting of the Council of Agriculture for Wales was held at the Raven Hotel, Shrewsbury, on the 13th October, 1922, with Mr. W. S. Miller in the chair. The meeting was called in accordance with the decision of the Council at its half-yearly statutory meeting in May in order to consider the report of the Sub-Committee appointed to draft suggestions for the formulation of an agricultural policy for Wales. The report of the Committee was considered in detail and adopted in the form in which it appears below.

I. **Production from the Land.**—We are of opinion that the land in Wales, which is mainly under grass, is not, from the point of view of the nation, producing what it should do in the way of food. We are convinced that a material increase in the production of cereals and forage crops is possible, and that this would result in a like increase in the output of live stock and live stock products. With the exception of a temporary change of practice during the war, there has been a steady and striking diminution in the area under cultivation in Wales during the period since 1871. A very large proportion of the land that has gone out of cultivation is now under grass of extremely poor quality, and the output from it is surprisingly low. That this land is capable

of improvement is evident from the results of experiments, but the area on which any systematic effort at improvement has been made, is, having regard to the total area involved, deplorably small.

A comparison between the areas under cultivation in 1871 and 1921 is shown in the table below :—

Crop.	1871. Acres.	1921. Acres.	% Decrease.
Wheat	126,334	38,750	69·3
Barley	169,751	86,716	48·9
Oats	253,672	229,464	9·5
Total Cereals	549,757	354,930	35·4
Potatoes	51,853	26,152	49·6
Turnips, Swedes and Mangolds	77,213	60,351	21·8
Arable Land	1,110,170	774,724	30·2

We are aware that, while the area under cultivation has decreased, the live stock of the country has increased during that period. We give below a table showing the live stock population under different heads in the years 1871 and 1921 :—

Class.	1871.	1921.	% Increase or Decrease.
Cattle	596,588	724,417	+ 21·4
Sheep	2,706,415	3,216,877	+ 18·9
Pigs	225,456	215,362	− 4·5

It is now generally recognised that, as a rule, the production of food on arable land is largely in excess of what it is on grass land. Although there has been a large increase in cattle and sheep in the period under review, it is, in our opinion, doubtful whether the increase that has taken place under these heads is sufficient to compensate for the reduction in the area of land under cultivation during the same period. Having regard to all the circumstances, we have serious doubt as to whether the present production of agricultural land in Wales, taken in terms of actual food values, is equal to what it was in 1871.

We have already drawn attention to the very large acreage of pasture in Wales that is of inferior quality, and this is apparent to everybody. It is true that much of the land is naturally poor and that grass of superior quality cannot be expected in these circumstances. We feel sure, however, that a very large proportion of the pasture land in Wales, even though it may be on soil that is naturally poor, can be much improved if proper methods are adopted to that end. The experience of the last twenty years has clearly demonstrated that such manures as basic slag can be used on pastures to enormous advantage. In view of the excellent results obtained in places where this has been tried, it is a matter for surprise, as well as concern, that the application of such manures to grass land has not become a much more extensive practice.

II. **Reform of the Land Laws.**—We urge the necessity for reforming the law as it relates to land so as to ensure to the tenant farmer—

(1) A fair rent, which, in all cases of dispute, should be fixed by arbitration, the right to demand such arbitration being given to both the owner and the tenant, the existing Acts, where necessary, being amended.

(2) Full compensation for all improvments, the Agricultural Holdings Acts, 1908 to 1921, being so amended as to enable a tenant to carry out

any improvement suitable for the ordinary working of the farm on notice being given to the owner, and to be entitled to compensation under the Acts unless the owner proves to the satisfaction of the Ministry of Agriculture, as an independent authority, that the proposed improvement is unnecessary, Part I of the First Schedule of the Act of 1908 being revised accordingly.

(3) Security of tenure conditional upon (*a*) the practice of good husbandry by the tenant (*b*) the land not being required in the public interest, or by the owner to farm either himself or by a member of his family, in which case he should be required to prove to the satisfaction of an independent authority that his grounds for requiring possession are reasonable.

We fully recognise that the landlord and tenant system which has long been a feature of the agricultural economy of this country has great and obvious advantages. It is clear, however, that, under the pressure of circumstances, that system is inevitably breaking up, and some other system has to be substituted for it to an increasing degree as the years pass. The demand for security of tenure on the part of tenant farmers is mainly due to the fact that so many owners choose, or are compelled, to dispose of their estates. The only alternative to the landlord and tenant system that could give the tenant a fuller measure of security would seem to be either universal State ownership of land or a scheme by which occupiers are enabled to become the owners of their own holdings. No system yet devised is free from some disadvantage.

We recognise that for the occupier to be the owner of his own farm is not wholly an advantage either to the farmer himself or to the State. Financial embarrassment in such cases is frequent, and, while there are exceptions, experience does not show that those who own their own holdings use the land to better purpose than those who are tenants. On the other hand, it is undeniable that a large number of those who have been brought up on the land, and of the smaller farmers particularly, have a strong desire to own their own holdings, partly because of the sense of security that ownership gives them, and partly also on quite other grounds. In view of this, we consider that the State should offer facilities to enable those who so desire to become the owners of their own holdings. On the same principle we are of opinion that, subject to proper conditions, the State should extend facilities to owners of estates for the purpose of improving and developing their properties.

III. **Position of Workers.**—We feel that there is need for improving the position of the agricultural labourer, both by securing for him an adequate wage, with the assistance of local Conciliation Boards, and by providing him with better opportunities for cultivating land on his own account. We urge upon agriculturists the desirability of providing land voluntarily for agricultural labourers, wherever possible. We also feel strongly that steps should be taken to provide, with the assistance of the State, local authorities and private owners, adequate and suitable housing accommodation, including tenements of the cottage holding type, in rural districts.

IV. **Small Holdings.**—We are fully in sympathy with the policy of creating Small Holdings with which the State is so definitely and closely identified. The mere splitting up of the land into holdings of a small size is

not, however, necessarily an advantage. We are satisfied that a large number of the small farms, so typical of Wales, are entirely uneconomic as they are. To be successful they should be either reduced still further in size or made larger. The nature of the land in many parts of the country is such that it can only be worked economically in large farms. It is also true that there is good land in favoured situations which could be put to much more profitable use if worked as intensive small holdings than is the case now when it forms part of medium sized holdings used for mixed farming or stock-raising. We are simply reiterating what every reformer has emphasised, when we say that it is essential, in the interests of the nation, to maintain a large and flourishing rural population, but we desire at least to associate ourselves with that view.

We consider that the creation of small holdings and the improvement of the position of the agricultural worker on the lines indicated in the preceding paragraph would go a long way towards solving the problem of maintaining a rural population, provided that a definite policy is pursued of selecting suitable men for the holdings, and that the holdings themselves are placed on suitable land and in favourable situations.

V. **Agricultural Education.**—Agriculturists have reasons to be gratified with the additional provision that has recently been made in connection with Agricultural Education and Research. So strongly convinced, however, are we that a high standard of Education and technical knowledge is to be more than ever the need of the agricultural community of the future, that we can regard the provision now made as adequate only for the time being. Although the position of Agricultural Education and Research is more satisfactory than it has ever been, we feel that much remains to be done in connection with general education in the rural districts of the country. In our opinion, the ordinary curriculum of the rural Elementary Schools should be adapted to the needs of the district, and in all such schools Elementary Science with a rural bias should be taught. We also consider that in any Continuation Schools that may be established in rural districts in the future the curriculum should be so framed as to arouse the pupils' interest in rural life. Amongst other things, we think it is eminently desirable, on educational and other grounds, that the attention of the pupils should be drawn to the principles of Economics and such subjects as Farm Accounts. Something in this direction might be done with advantage even in the Elementary Schools.

VI. **Road Transport.**—We strongly urge the necessity for improving and widening existing district roads and for the construction of new roads to provide routes for road motors to convey traffic between country districts and railway centres.

VII. **Credit.**—We consider that a Credit Scheme on the lines of the scheme in operation during the War should be established and so developed as to enable farmers and smallholders to obtain temporary assistance for the purpose of carrying on their business.

VIII. **Land Drainage.**—For the country as a whole there is hardly any improvement that is more needed than land drainage, and we are greatly concerned that operations under the Drainage Act of 1918 have had to be suspended. We strongly recommend that the provisions of the Act should be put fully into operation as soon as possible, as we are convinced that large

tracts of land in Wales that are now useless for agricultural purposes, would, if properly drained, become highly productive.

IX. **Local Taxation.**—We are of opinion that it is necessary to readjust the burden of local taxation so far as it affects agricultural land, inasmuch as under the present system the farming industry is over-rated. The farmer's business involves the occupation of a disproportionate amount of rateable property, as regards its income earning capacity, as compared with other industries, and certain of the services in respect of which rates are levied are of less benefit to the farmer than to the other classes of the community.

We would call attention to the view expressed in the Majority Report of the Royal Commission on Local Taxation, 1896, to the effect that, in view of the character of agricultural property and the amount of the profits derivable therefrom, and the relative extent to which benefits accrued to the property and to its occupier by reason of the expenditure incurred by local authorities' it would be inequitable were rates to be paid on the basis of its full annual value. This was recognised in the Agricultural Rates Act of 1896, which made provision for the assessment of agricultural land at one-half of its rateable value, a fixed contribution equivalent to one-half of the rates paid on agricultural land in 1895 being made from the exchequer. While, however, the rates have increased enormously since that year, the relief afforded under the Act of 1896 has remained the same. It is readily admitted that the incidence of local taxation at the present time is unjust, and that the whole system of assessment to local rates requires reconsideration. Pending opportunity for such revision, we consider that the differential rating in favour of agricultural land should be extended, and that for rating purposes the occupier of agricultural land should be called upon to pay rates on one-fourth instead of one-half of its rateable value, the deficiency being made good by means of an Exchequer grant to the Rating Authorities.

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THE DUCK AS AN EGG-PRODUCER.

A. T. JOHNSON.

DURING the last two or three years the extraordinary prolificacy of the laying breeds of ducks has been brought prominently to public notice by the wonderful results attained at laying tests. These events, however, while undoubtedly proving the great superiority of certain strains of ducks over pullets of the highest fecundity, in so far as number and weight of eggs are concerned, do not indicate what is to the farming community no less important, viz., the peculiar position of the laying duck as an asset in the economics of agriculture. To know what a flock of Runner or Khaki Campbell ducks is capable of producing under certain conditions is of undeniable value; but the farmer must also know what such a flock is likely to do under free range management where there are considerations to be met which do not occur within the enclosures of the laying test.

It may therefore serve a useful purpose to discuss briefly the merits of the laying duck in its relation to the ordinary practices of farming. It may be said, in passing, that, phenomenal as the fecundity of the ducks competing in the tests has been, it is the opinion of practical duck-keeping farmers, that if such results can be achieved in the conditions prevailing at these tests there is reason to believe that they can be equalled on the farm. That, indeed, has been my own experience in free-range duck farming for eggs.

Of not less significance than heavy laying is the question of upkeep. Here the farmer is at a distinct advantage, and it is this matter of upkeep, or cost of production, together with its bearing not only upon direct profits but upon the economics of farm practice which must be emphasised here.

The laying duck is essentially a forager, and that characteristic is so strongly marked that the Indian Runner is to the old farm waddler what a light and active, laying-type Leghorn is to some lethargic Asiatic table bird. Given a wide range on almost any kind of land and the Runner will very nearly feed itself from spring to autumn, though many duck-keepers consider that it generally pays to give a good feed at night. During that period, for example, I have maintained flocks of these ducks on a single light feed of oats, or dredge corn, daily, and they have laid abundantly. Not infrequently, indeed, as during warm, rainy weather when the forage was good, or when the birds were on stubble, hand feeding has been entirely suspended without the egg yield being impaired in the slightest degree.

Significant as these things are in considering the financial aspect of the matter, the farmer will not lose sight of the fact that in maintaining itself and providing eggs the laying duck is doing great service by destroying insect pests. The income derived from its eggs may be the only direct and tangible return upon which to estimate the bird's actual value to the balance sheet, but few of us who have kept such flocks in field colonies but will do the duck due justice by crediting it with taking the part of pest destroyer in the general scheme of farm work, and this is not to be considered lightly.

Omnivorous as the duck is, it is animal food which she seeks with the greatest keenness, and the more she lays the acuter becomes her appetite for such a diet. Those who have kept laying ducks in confined areas know full well how necessary meat in some form is to good laying, how much more necessary it is

than for laying hens. It is the natural craving for proteids in the shape of insect life which makes the Runner duck such an untiring forager.

Farm land varies considerably in the quantity of insect life and grubs which it carries, but few farms, grass or arable, are so fortunate as not to be sufficiently stocked with pests of this kind to keep busily employed flocks of ducks disposed at the rate of 6 to 10 to the acre. I have, on suitable land, kept fully twice as many birds the seasons through for several successive years, but the best of feeding ground becomes exhausted, so that periodical changes are desirable. The fact that flocks of these ducks will considerably reduce the stock of insect life on a given area supports the contention made by some people that such birds are natural destroyers of many noxious insects.

Perhaps one of the most noteworthy examples of what such ducks are capable of performing on behalf of agriculture is that afforded by the fact that to my knowledge they are devourers of the fresh water snail which is directly responsible for liver-fluke in sheep.

At certain periods of the year I have known Runner ducks to devour enormous numbers of crane flies (the parents of the leather-jacket grub) as these emerged from their pupa cases, and as the " rise " from the pasture of this destructive insect often takes place during the dusk of late evening, ducks, which are often most active at such an hour, have an opportunity if not shut up too early of securing this prey which other poultry cannot enjoy.

Slugs and snails are eaten with great avidity by ducks, and there are instances on record which tell us how a flock of these birds has completely eradicated the little white slug which is often so injurious to clover and other pasturage. The click-beetle (parent of the wire-worm) is also sought for and devoured, as examinations of crop contents have plainly shown, and another pest which, like the crane-fly, is often to be secured at dusk, is the cockchafer. These fat and luscious morsels, both the young adults as they emerge from the ground and the egg-depositing females, are greedily swallowed by foraging ducks.

Though it is doubtful whether ducks are able to have much effect in destroying noxious larvæ in grass the same end is eventually achieved by the eradication of the parent insects. On arable land, however, especially when ploughing or other work is in progress, the quantity of wire-worm, leather-jackets, chafer grubs and other larvæ eaten by ducks is enormous. Their appe-

tites never flag when such fare is being turned up, and so long as the ploughman is at work so long will they follow at his heels, and examine every particle of the soil much more thoroughly and exhaustively than will the attendant gulls and rooks.

One need not dwell further upon the stimulating effect which this insect fare has upon the prolificacy of laying ducks, nor is it necessary to point out the convincing lesson in agricultural economics which is conveyed by the above statements. Practical, wide-awake farmers can draw their own conclusions.

There are one or two other matters, however, which may be mentioned, and one of these is the question of injury to growing crops which may be done by flocks of ducks. In regard to this one can confidently say that no class of poultry is more easily kept within bounds than ducks, and it is the common experience of all who have kept them that they prefer pasture or waste land to arable. Since they do not scratch, ducks can range fields of young roots, potatoes and other crops without doing other than good, and the flocks can be run on seed grass and clover without any fear of the young plants being injured as may sometimes happen with other poultry.

They will, however, eat and damage any young plants of the cabbage tribe, and will burrow for newly-sown corn, and may consequently be poisoned by copper sulphate used as a seed dressing.

Finally, the Indian Runner, and indeed most of the laying breeds, keep perfectly healthy and produce fertile eggs without swimming water. All they need is water to drink, morning and evening, and the realisation of this characteristic should remove what has for generations bred an antipathy towards ducks on the farm, viz., the complaint that they foul the drinking water of other live-stock.

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DRY-MEAL HOPPERS FOR PIGS.

CAPTAIN CALLCOTT REILLY, M.B.E., B.Sc.

WHAT may be termed the self-feeding of dry meal to pigs is a question that is receiving considerable attention at present, and hence certain results obtained, and reasons for adopting this method on a commercial scale, may be of some interest. This article has reference to a commercial herd of some sixty sows, all the progeny of which are kept on the farm, and fattened for a co-operative bacon factory.

The herd was started in 1920 by a Danish bailiff, to be run on Danish lines. Good farrowing and fattening sties were built, but the pigs did not do as well as might have been expected. The experiment was tried of running pigs in the store stage out in orchards, which was an improvement. Then the sows with their litters were run in orchards, which was another improvement—scour in the piglings, which had been a source of trouble, becoming very much less prevalent. The pigs in the fattening sties, although well fed three times a day and kept scrupulously clean, did not thrive as they might have done, and the net result was that the pigs, weighing about 16 stone alive, averaged nearly 9 months old when ready for the factory.

Experiment with Store Pigs.—It was while seeking for improvements that papers by Professor Evvard, of Iowa, U.S.A., were obtained. at the end of 1921, describing the remarkable results achieved by self-feeding pigs, and allowing them their choice of carbohydrates and albuminoids. It was therefore decided to try the method on a bunch of young stores running out. A self-feeder was improvised out of an old sheep hay rack, by fixing flat galvanised iron sheets inside the V rods, and cutting holes at the bottom for the meal to run through into the trough. The hopper thus contrived was divided transversely into half a dozen different compartments, and a different feed placed in each, in order to see which the pigs preferred. The results were as follows: —

31 store pigs, weighing from 6 to 8 stone each, live weight, ate in 7 days:—

Mixed meal (maize, wheat, and barley, ground together in equal proportions)	49 stone.
Rice meal	22 „
Fish meal	8 „
Palm kernel cake	5 „
Whole peas (soaked)	10 „
Whole maize „	4 „

Average, 6 lb. per pig per day.
Nutritive ratio, albuminoids to carbohydrates, 4·7.

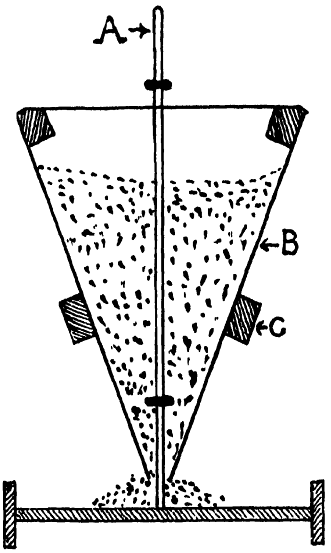

FIG. 1.—Cross Section of Feeder in Sty.
A.—Iron railing dividing the sties.
B.—Galvanised iron sheeting.
C.—Tongued and grooved board ends.

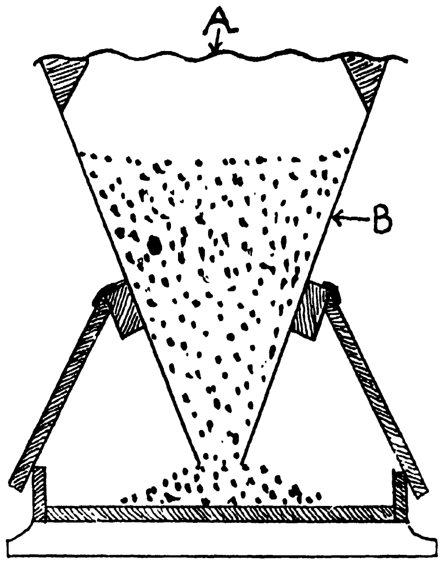

FIG. 2.—Cross Section of Feeder shown in Fig 3.

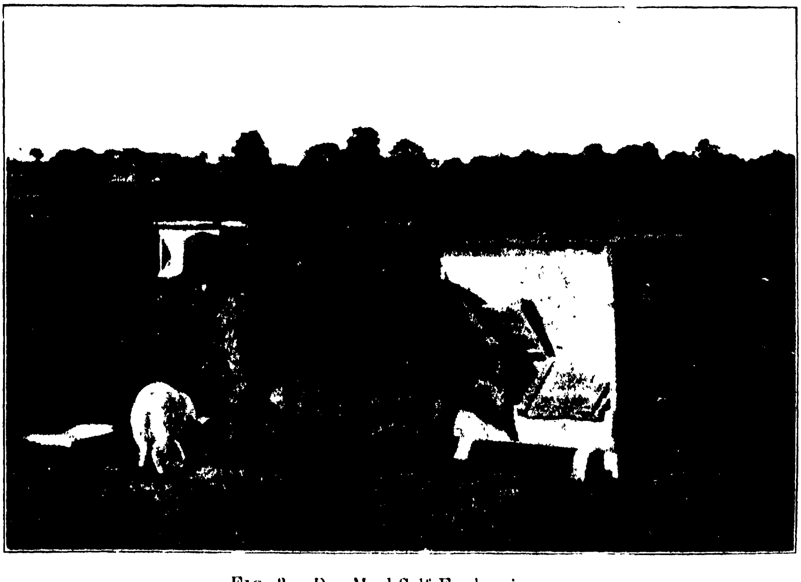

FIG. 3.—Dry Meal Self-Feeders in use.

It will be noticed that the pigs rationed themselves very well, but that they were not keen on palm kernel cake. The hoppers were always kept full, except those containing whole soaked peas and maize, as the pigs ate these as quickly as they were put in. They were therefore discontinued after two days.

The pigs obviously ate too much at first, but as they got used to self-feeding the consumption dropped, and after a short time they were only averaging $4\frac{3}{4}$ lb. per pig per day.

On various occasions the amount of meal consumed by bunches of pigs has been weighed before being put into the hoppers, with the following results:—

No. of stores.	*Average live weight stones.*	*Meal per pig per day. lb.*	*Period of weighing meal.*
35	9	4·7	3 weeks.
20	9	4·8	1 "
20	9	4·75	2 "
15	8	4·8	1 "
17	6	4·1	2 "
18	6	4·2	3 "

Before dry feeding was adopted, the pigs were allowed a ration of $4\frac{1}{2}$ lb. per day, and as much green stuff and roots as they would eat. The all-round improvement in their condition after being dry fed for some weeks was very marked, particularly among the smaller pigs, which now got all the meal they wanted, and were not thrust aside by the larger ones.

Fattening Experiment.—An experiment was then carried out in the fattening pens, where there were facilities for weighing the pigs. A bunch of 12 stores was divided as nearly as possible into two equal lots; one lot was dry fed, and the other lot slop fed three times a day, with as much food as they would clear up. The period of the experiment was six weeks and the following were the results:—

	6 pigs on wet food.	*6 pigs on dry food.*
Original weight ...	51 stone 4 lb. ...	51 stone 1 lb.
Final weight	78 " 1 " ...	87 " 11 "
Meal consumed ...	116 " ...	151 "
Meal consumed per lb. live weight gained...	4·4 lb.	4·1 lb.
Average daily gain per pig	$1\frac{1}{2}$ lb.	2 lb.

The stores had been used to slop feed when the test began.

This test was enough to show that, taking into consideration the great saving in labour, dry feeding was likely to be a paying proposition, and double dry feeders were installed in every other

partition between the sties. These were roughly constructed as shown in the cross section, the sides of the hopper being made of flat galvanized iron. The length is 3 ft., which is found to be ample for two pigs to feed simultaneously on either side.

Sows and Litters.—Dry feeders were now tried with great success for the sows and litters, and the result has been that the sows milk better, the little pigs never suffer from scour, and there are no difficulties at weaning time, as they start eating the dry meal, which is always sweet, and carry straight on with it after weaning without the usual set-back.

Stores.—For a month after weaning the stores are dry fed in orchards, and several advantages are noticeable, the most important of which is that no matter how many are run together, they all get an equal chance. After this stage they are usually folded on vetches, kale or roots, and are not dry fed, but have soaked whole maize and beans thrown to them, in order to make them live chiefly on the green food. At about 9 stone live weight they go to the fattening sties, where they are again put on dry food, and a constant supply of green stuff or roots, which is most important. Of course the pigs must always have water, and a very interesting point is that the amount of water consumed in the fattening pens is now only half of what it was under the slop system of feeding.

In-Pig Sows.—An experiment has been made with success in dry feeding the in-pig sows. It was found that by feeding only palm kernel cake and fish meal, neither of which is very palatable, with green stuff, the sows did not get too fat, but kept in nice breeding condition, only consuming about 5 lb. of meal per head per day.

As this is purely a commercial farm, there has not been time or opportunity for a number of interesting experiments which might have been carried out, but the main result of dry feeding has been that the average age of the bacon pig has been reduced from 9 months to 7 months and a substantial saving in meal and a great saving in labour have been effected.

For outside use it was found that a door over the food troughs was necessary, in order to prevent the meal from being blown away, and to keep out birds and vermin. At first a vertical swing door that pushed inwards was adopted, but it was found that the pig usually took a mouthful of meal, withdrew its head to chew it, and dropped a certain amount on the ground. Lift-up flap doors were then adopted with great success. The pig has

to nose up the door, which rests on its head, and does not withdraw until it has finished feeding, thus entirely eliminating waste.

One difficulty with self-feeding is the cost of the feeders, most of those on the market costing over £10 apiece. The one shown in the photograph was home made, but farmers who have no facilities for making them may purchase well-made feeders to take four pigs at a time for the very reasonable sum of £2 19s. 6d. each.

There is little doubt that self-feeding pigs has come to stay, as by this method the pig is correctly fed, little and often, all pigs get the same opportunity, and there is a large saving in the labour bill; also the difficulty of correctly rationing the pigs is eliminated with the self-choice system, as the pigs ration themselves.

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THE CRATE-ROD AND BARREL-HOOP TRADES.

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Lack of Intercourse between Producer and Consumer.—Crates and barrels are in constant use for packing pottery, jam, fish, bottles and many kinds of "dry goods," and in the south of England are many acres of hazel whence rods and hoops can be obtained. The Potteries of Staffordshire form one of the important markets for crate-wood and barrel-hoops. The trade probably survives spasmodically in most of the districts where plenty of hazel can be found. But one suspects that many opportunities are wasted through lack of knowledge concerning mutual requirements, and that with a better understanding at either end the trade might be stabilised and greatly improved. Woodcraftsmen and estate agents know little of the exact requirements of the trade or the pressure of foreign competition and the reasons for it; the coopers and crate-makers and potters of Staffordshire know little of the woodland districts and the conditions under which the wood is grown and worked. For example, the owner of certain osier-beds which had not been cut for four years wanted to sell the rods to a crate-maker. Unfortunately he cut them too late in the season; willow crate rods are used while green, but are not worth stacking for later use.

Therefore the rods remained unsold. Another example is seen in the statement made in Cornwall that French hazel hoops are better than English, being more "suent." On inquiry in the Pottery towns it was learnt that French hoops are cut at shorter intervals, and are therefore more suitable than English ones for small fish-barrels, but no use at all for the big pottery "tubs" used in Staffordshire. Closer contact with the market would enable estate agents or the estate woodmen to cut at the right periods for the most convenient market, and would induce them to devote more care to those woods that are favoured by soil, aspect and situation for producing what is required. If a manufacturer can save his labour costs by getting better material, it is worth his while to give a better price.

Casual Growth of Trade Connections.—The following story will illustrate the casual way in which trade connections grow up, and explains the tenacity with which they are kept up once they are made, and the sudden collapse that may occur in a small industry if a trade connection is broken through death or from some other cause.

A crate-maker in the Potteries who was setting up in business applied to the local goods station for a list of firms from whom crate-rods and barrel-hoops had been received. He wrote to the man whose name happened to come at the head of the list, and has dealt with him ever since. On getting an inquiry for crate-rods, this man, who lived near Basingstoke, replied that he was willing to send them but wanted to know how he would get the money. Whereat the crate-maker promptly sent him a cheque for £50, and told him it would be "quite all right: you have only to take it to one of the local tradesmen and ask him to cash it for you, and send along the stuff as soon as it is ready." This confidence was not abused, the consignment of wood arrived in due course and cheques and crate-rods continued to be exchanged periodically. Curiosity at length caused the dealer to visit the unknown but open-handed crate-maker who was making his fortune. He returned with much information concerning the trade and general conditions in the Pottery Towns that could not fail to be of use to him, and with the idea, quite new to the small-holders and farmers of the Hampshire woodlands, that such information could be freely passed about amongst rival crate-makers and coopers. "In the south," said the crate-maker, "the less you say the more they think of you. Here we are very free."

Barrel-Hoop and Crate-Rod Making in Hampshire.—The woodland industries of Hampshire and Berkshire, with the local system of ownership, cultivation and dealing, have been described elsewhere.* Barrel-hoop shaving and crate-rod cutting are branches of the woodman's art, rather than separate trades. Crate-rods are of several sizes and are sold in bundles known as "seventy-fives," "forties," and "twenties."† For barrel-hoops rather stouter hazel wands are split with a blunt tool to two or three or four bands and shaved on the inner surface so that they lie flat against the barrel. The bark forms the rounded outer surface. The wood is cut to the various lengths required by means of a simple measuring apparatus, consisting of a row of stakes driven into the ground at the correct intervals. Barrel-hoops differ from 2½ ft. to 15 ft. in length. The Hampshire names for the hoops are "daughters," 2½ ft.; "short pink," 5 ft.; "long pink," 6 ft.; "firkin," 7 ft.; "kiliken," 8 ft. Nine feet, ten feet, and all the intermediate half-sizes have no other name, but eleven feet is "short pipe"; twelve feet "long pipe"; thirteen feet "middling," and fourteen feet "swinger." It is said to take about a month to learn the work so as to do it at a remunerative pace, and it would be a valuable occupation for a woodman which might keep him busy the whole winter.

It is not surprising that potters and coopers prefer to trade with some known dealer rather than with the "little farmers," as they call the rural wood dealers, who are sometimes uneducated and illiterate. Talking of unreliable deliveries, a crate-maker said, "I am not particular if there's a bundle or two short, but if it goes on every time, I get up against something." The unreliability is not only on the side of the woodlanders. Fluctuations which have made the trade so risky for the woodlanders and local dealers have sometimes been due to bankruptcy or to dishonourable practices amongst crate-makers. Consignments have been ordered in advance and when the time has come for payment, excuses have been made that the material was faulty; or the vendor has been recommended to sell his stock to some other crate-maker because the man who ordered it no longer requires it; or the purchaser, having resold the consignment at a profit, has disappeared without paying for it. Even if such cases are rare, there have been enough to shake the confidence of men far away with no knowledge of business, who could get no

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* *The Rural Industries Round Oxford*, pp. 79–102.

† The prices quoted in the spring of 1921 were 2s., 1s. 9d. and 1s. 6d. respectively.

guarantee of good faith, and they are not soon forgotten. Fortunately, organisation is extending to the Staffordshire crate-makers and coopers, and in their own interests they are anxious to put an end to such practices. A wood dealer if only he knew it, can now refer to the Secretary of the Crate-Makers' and Coopers' Association, 38, Albion Street, Hanley, Staffs., with inquiries as to the reputation of any cooper or crate-maker who wishes to buy from him.

Coiling of Barrel-Hoops.—Barrel-hoops are tied into straight bundles of fifty, sorted according to size, and are usually despatched thus from the Basingstoke district. Nevertheless, coopers and potters prefer to get them ready coiled, even though freights are a little higher owing to the greater space required for coiled hoops in transit Coiling used to be done at Aldermaston but it died out before the War and has only recently been resumed. Meanwhile the rods were sent to London to be coiled by London coopers, who apparently had big coiling plants. Basingstoke barrel-hoops and crate-rods are known in Staffordshire and elsewhere as "London" rods or hoops, no doubt owing to the enterprise of some London cooper who bought them from the country and distributed them. It seems wasteful for such cheap goods as barrel-hoops to bear the double transport expenses incurred in sending them to London to be coiled and then to the Potteries or to some other market, and except for the London market it would appear to be more economical to coil them at the source. A big Staffordshire firm of coopers set up a coiling plant during the War because it was unable to procure coiled hoops, and had big packing contracts. After the War the plant was sold, since even in this big cooperage there was not enough work to keep the plant busy for more than about one day in the week, so the capital was lying idle. Coiling can easily be done by a very simple apparatus while the wood is green, and when dry the wood can be soaked and coiled inside a cylinder to dry, so that it keeps its shape after removal and can easily be held in position while the cooper fastens it to the barrel. If a large trade were to be organised from one of the railway stations such as Aldermaston or Alton whence wood is despatched, coiling machinery might pay, and it is quite possible that the difficulty is merely that of collecting sufficient capital to buy up local barrel-hoops in large quantities. Many difficulties might be solved by passing all the local crate and barrel-hoop wood through the hands of a local coiling, packing

and distributing firm, and the increasing organisation at the market end of the trade should tend to make such a venture safer than it could otherwise be.

Stacking Barrel-Hoops and Crate-Rods.—Small consignments of hazel barrel-hoops and crate-rods are wanted during the winter months for current use while green. Workmen prefer to use them green while they are easy to bend and twist. The bulk of the wood, however, is sent off in the spring for stacking. If properly stacked it is said to keep in good condition for two years. The stacking is important, for if there should be a slump in the pottery trade and consequently in crate-rods, a wood dealer may incur very heavy losses through deterioration by keeping his stock a whole year. A piece of bark is stripped off the whole length of the wood for barrel-hoops to prevent rotting. Crate-rods, which are finer, are merely stacked when dry, the butt ends outwards, and protected from the wet with a thatch of twigs. The larger wood for "crate heads" is "scotched," *i.e.*, a patch of bark removed.

By April or May the wood has become dryer and lighter, and consequently freights are lower. In January, 1921, when the wood was wet and heavy, a load of crate-wood from Alton, Hampshire, weighing 3 tons 13 cwt., cost as much as £7 4s. 10d. in carriage, whereas in May two loads from Aldermaston in Berkshire travelled for £5 18s. 8d. and £2 2s. 5d. respectively. From Market Drayton in Staffordshire a load costing £5 was procured at a cost of only 10s. in carriage.

Crate-Making, Importance of Good Material.—Crate-making has not even yet entirely died out as a rural industry in Staffordshire, though the bulk of the industry has come to the towns, not only because made-up crates are bulky and inconvenient to take in from the country, but for other reasons. A master explained:—"It is education; the men found that they could come into the towns and get the best material to work on, and earn more money. They won't moil themselves over work when they see others getting more pay for less work!" Crate-making shares with other trades the reputation amongst its workers of being the "most down-trodden trade in existence." In the country in Staffordshire the earnings were only about fifteen shillings a week, and probably more precarious than the agricultural wages.

A master crate-maker who had himself been a workman laid great stress on the importance of getting the exact sizes, shapes,

and kinds of material. The poles for crate-heads, which are the stout pieces forming the corner uprights of the crate, should either be only thick enough for one, or just thick enough for two, crate-heads. If thicker, too much labour is involved in splitting them up. They should be straight enough for straight lengths of three or four feet to be cut from them, but need not be so straight as for turnery, since these would probably be dearer. As to the kind of wood for the crate-heads the crate-maker was indifferent, though he did not much care for fir on account of its knots.

Dutch Competition in the Barrel-Hoop Trade.—Bad trade in the woodland districts is laid at the door of foreign competition. It is true that Dutch willow hoops have been coming to the potteries at about a quarter of the price of the English hazel hoops. One firm of coopers estimated that only 30 per cent. of its barrels could have English hoops at the current prices (August, 1921). These would be put on the best and biggest barrels, on which the extra price could be charged. Competition from Holland is due to the fact that the dykes are planted with willows which help to hold them up: the sale of the rods is of secondary importance to the safety from floods. "The Dutch hoops are cheaper because they can't help growing them," said one of the coopers. The greater increase of overland freights in England as compared with water transport has made Dutch competition especially severe since the War. For example, in the spring of 1921 a bundle of English 6-ft. barrel-hoops from Sussex cost 4s. 3d., including 1s. for carriage, and a bundle of Dutch hoops cost only 1s 0½d. including 7d. carriage. In consequence, although the English hazel hoops are far superior to the Dutch willow hoops, coopers can only use them on the best and most expensive barrels. Sometimes a barrel has a couple of English hoops as well as the Dutch ones, to give extra strength. Hazel hoops are stronger and more durable than willow, and will stand storing when dry. Willow is only suitable for use while green. Thus it is seen that foreign competition, severely as it hits the English hazel barrel-hoop trade, yet leaves room for a certain proportion of English goods owing to their superior quality. The proportion will vary according to the condition of trade in the pottery and other dry-goods trades using barrels for packing.

Relative Demand for Barrel-Hoops and Crate-Rods.—The market for English barrel-hoops and crate-rods might be im-

proved if freights could be reduced. Pottery for export is packed in "tubs" or barrels, except for big ware which is packed in crates. For the home trade only about one-fifth to one-sixth of the ware is packed in barrels, and the rest in crates. There has been much pilfering from crates at the ports and therefore companies have refused to insure small pottery unless it is packed for export in enclosed packages. The two crafts of crate-rod cutting and barrel-hoop shaving are branches of the woodman's art rather than separate industries, since the material for either can be found in the same woods, the same woodman can prepare both with a little experience, and the destination is the same for both. There is no direct foreign competition in the crate-wood trade, therefore it would be well, at times when foreign competition hits the barrel-hoop trade, to be able to turn to the other trade.

The crate-makers affirm that pottery manufacturers will only make their own crates if they can get plenty of cheap material and do it at a low cost. To protect their trade, the crate-makers must be sure of getting the material, and an interesting suggestion was made, emanating, it must be admitted, from a firm of coopers, not crate-makers. This was to keep up the price of crate-wood, which is the staple trade and does not suffer from foreign competition, and to lower the price of barrel-hoops so that there should be less disparity between the English and Dutch prices. The suggestion is quite in accordance with rural practice in regard to various wood products, especially where there are mixed woods. For example:—"We can't make a profit on firewood alone, it doesn't pay for the cutting; so we make up on turnery poles which fetch a good price if grown straight." "When we did a big trade in hop-poles, there was a lot of work in the woods, and it paid men to make barrel-hoops and crate-rods and hurdles." It may be, therefore, that organisation for protective purposes among the Master Crate-Makers and Coopers, may have a good influence on the conditions among the woodlanders. If there were some corresponding local organisation through which the interests of the landowners, woodland craftsmen, and local dealers could be expressed, much might be done to stabilise the uncertain and spasmodic woodland industries.

Conclusion.—It is useless to expect any appreciable improvement in the position of the English woodlanders unless market conditions are watched, not only by the dealers who buy up coppice-wood, but by the estate agents or landowners who are responsible

for looking after the woods, can choose which coppices are worth regular attention in the matter of draining, clearing and replacing dead stocks, and decide at what interval each coppice should be cut. The crate-rod and barrel-hoop trade shows need of attention to the supplies of wood, and it gives one illustration among many, of the need for an Intelligence Bureau to which all who are interested in woodland industries can contribute, and apply for information. Such information cannot be made available to the local people most concerned unless there is a local organisation to correspond.

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SEEDS AND GOOD CROPS.

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THE first essential towards the production of a first-class crop is to use only first-class seed. Such a description involves :—

(*a*) Variety best suited to the land.
(*b*) Good strain.
(*c*) High purity.
(*d*) Good germination.
(*e*) Suitable country of origin.

Variety.—Experience will be the most useful guide as regards variety, and here the seedsman may be able to help, for he has opportunities of observing the different classes of seed growing on various soils and of comparing the resulting crops and yields. The County Agricultural Organiser should be able to give some information on variety trials in the county. Experiments can also be tried by growing two or three varieties in the same field and carefully watching the results.

Good strain is of great importance in cereals and roots, as these crops are liable to get very impure and poor after a few years. Great trouble is taken by the big seed growers to keep pure strong stocks of their seeds; inspection and rogueing of growing crops is rigorously carried out; and the resulting seed is cleaned very carefully—all small and immature seed being eliminated. This labour adds considerably to the cost of the seed, but it will add much more to the resulting yield, and in the case of cereals to the value of the grain when marketed. The cost of the seed is not a big item in the cost of raising a crop, and a few shillings more per acre will usually be well repaid by an increased crop. This has been demonstrated repeatedly by

experiments. The purchase of seed from reliable merchants is the safest plan.

Purity means freedom from other crop seeds, weed seeds, broken seeds, dirt, etc. This is of great importance, and only seed of the very highest purity should be used. The Seeds Act, 1920, provides that sellers of the most important agricultural seeds shall always declare the purity of these seeds: in the case of vegetable and root seed a standard of purity has been fixed (97 per cent.), but in the case of grasses and clovers the actual figure must be stated. When purchasing seed farmers should demand to know the purity. Two other points are provided for by the Seeds Act:—(1) the presence of certain weed seeds, described as injurious weed seeds, if in excess of 1 per cent. in clovers or 2 per cent. in grasses, must always be declared. The scheduled injurious weeds are docks, sorrel, soft cranesbill, cut-leaved cranesbill, soft brome grass, Yorkshire fog, and wild carrot. (2) The presence of dodder, which must be declared if in excess of one seed in a 4-oz. sample. Dodder is a parasitic plant which lives on clover and very speedily destroys any clover plant that it attacks.

Good Germination.—A high percentage of germination is very desirable. It is unreasonable to suggest that if the percentage of germination is only 50 per cent. twice as much seed may be sown. This plan is very costly, while a low germination frequently indicates poor vitality, which will enable weeds to establish themselves before the crop. This will very much weaken, if not entirely destroy it.

By the Seeds Act the seller is required to state the actual percentage of germination, or where a standard is fixed, a statement that the seed is above the authorised minimum percentage is sufficient, provided that the authorised minimum figure be stated.

Country of Origin.—This is especially of importance in the case of clover seed, which is imported into this country from numerous places—France, America, Canada, Chili, Silesia, New Zealand.

Good English seed is usually insufficient to meet actual requirements and is dearer than other seed. It is the most suitable to use in almost all parts of England. Foreign seed often looks a better sample than English, and may have a somewhat higher percentage of germination, and the price being lower it seems an attractive purchase, but in the English climate a better plant will

usually be obtained from English seed. Care should be taken to observe that the country of origin is stated when buying clovers and grasses, as is required by the Seeds Act. In short, to obtain the best chance of a good crop, three factors bearing on the seed used must be borne in mind:—

(1) Experiments made by the farmer himself, or by others, must be studied to determine the most suitable variety.

(2) Only seedsmen on whom one can rely should be dealt with.

(3) The analysis required by the Seeds Act should be read and the information it gives should be used.

Farmers might usefully have seeds tested at the Official Seed Testing Station, before sowing. Particulars as to size of sample, where to send it and fees for testing, may be obtained from the Chief Officer, Official Seed Testing Station, Huntingdon Road, Cambridge. Full details of the Seeds Act may be obtained by purchasing the Seeds Act, 1920, and the Seeds Regulations, 1922, price 3d. each, from any newsagent. Special facilities are provided for the testing of seeds for farmers when the analysis is required solely for the farmers' own information, and not in connection with a sale of seeds. The fee charged in this case is the nominal one of 6d. per sample.

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SPRING-TAILS ATTACKING MANGOLDS.

From the Ministry's Pathological Laboratory, Harpenden, Herts.

AMONGST the various types of diseased and damaged mangolds submitted during the current season to the Ministry's Pathological Laboratory for diagnosis. there was one affecting seedling plants that calls for special mention, as, though not uncommon in previous years, it has not been certainly attributed to any definite cause.

The injury to the young plant would give the impression that the root had been constricted at the soil level, just below the crown, the crown itself and the remaining root below ground being of more or less normal development. This apparent constriction frequently increases in intensity until the affected portion becomes threadlike, and in the process of singling or

during a high wind the top portion of the plant becomes separated from the lower.

To avoid confusion it is also necessary to mention a not dissimilar type of damage where the root *below* ground becomes threadlike, the portion above remaining intact. The cause of this damage is well known, however, being due to the attack of a minute beetle, *Atomaria linearis*.

As a result of an investigation in a field of attacked plants exhibiting the type of damage first mentioned—a threadlike condition of the root above ground—very large numbers of a minute Spring-tail (*Collembola*) were found to be present upon the plants and surrounding soil, while many of the insects were seen to be feeding upon the mangolds at the affected parts and causing quite a conspicuous bleeding.

Collembola are primitive insects without wings, and the particular members of the Order (*Bourletiella hortensis*, Fitch = *pruinosus*, Tulb.) in question are very small slate-coloured globular creatures capable of leaping considerable distances. They immediately scatter when the plants are approached. This, in conjunction with their small size, probably accounts for their not having been hitherto associated (according to the literature so far consulted) with the particular form of damage done, as no plant on being handled for examination would reveal a specimen.

It should be added that, although it is extremely probable that these insects are the first and only cause of the threadlike condition of young mangold plants above ground, this has not been definitely proved. These observations are made rather as giving a possible clue and to promote further investigation by those interested, than to suggest that a final settlement of the problem has been arrived at.

Bourletiella (*Smynthurus*) *hortensis* has previously been reported as injuring various crops, including mangolds, in this country and abroad, but does not appear to have been associated with the particular form of damage under consideration.

As the insects never feed on a root below ground level, it is probable that, when feasible, earthing up the seedling plants so that no roots are exposed would tend to ward off an attack. It is noteworthy that varieties of mangolds are susceptible according to the amount of exposed root exhibited above ground in the early stages of growth, which appeared on the fields examined to be a characteristic of yellow rather than red mangolds.

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LIQUORICE GROWING.

DAVID G. McIVER,
Ministry of Agriculture and Fisheries.

THE Liquorice plant, *Glycyrrhiza glabra*, is a native of North Africa, Southern Europe, and Asia Minor, and is cultivated in France, Italy, Spain, Southern Russia and the United States, and to a slight extent in England. The plant is grown for its root, from which is obtained the liquorice of commerce, chiefly used in medicinal preparations, and also in brewing and flavouring tobacco. In England the home-grown root is almost entirely used for chewing purposes. The cultivation of liquorice in this country is now confined to the district between Pontefract and Knottingley in Yorkshire, although a few years back there were two or three centres near London where it was grown.

The liquorice has been grown in the Pontefract district for several generations, and there is no doubt that the Pomfret Cakes which are made in the district, and which are a liquorice preparation, were originally made from the home-grown root. The Pomfret Cakes of to-day are probably made from the imported article. The Yorkshire-grown liquorice, as already stated, is practically all sold for chewing purposes and is chiefly consumed in the Northern towns, such as Newcastle, Hull, Leeds and Manchester. It has a very definite selling season—the months of October and November—and any roots not sold by the beginning of December are stored in sand until the following season.

The acreage under the crop is gradually diminishing and whereas a few years back there was an acreage of about 200, only a quarter of that area is cultivated now. A deep medium soil, such as is found between Pontefract and Knottingley, is essential for its cultivation as it is impossible to get roots up to 4 ft. in length, and more sometimes, unless the soil has a good depth.

The plants remain in the beds as a rule for four years, although occasionally they are lifted in the third, and sometimes when they have done badly or the market is flat they may be left for five years.

The system of cultivation practised in the Yorkshire district is as follows:—

Little preparation of the ground is necessary because it is usual for one liquorice crop to follow another and as the process

of lifting the roots entails the moving of the soil to a depth of three to four feet it can be readily seen that the ground will be left in a well tilled condition for the next crop.

The soil before planting as a rule receives a dressing of between 30 and 40 tons of manure per acre. Planting takes place during the end of March and early April, the land having previously been worked into flattened ridges about 3¼ ft. apart and 4 in. high. Two rows of sets are planted on each ridge, the sets being placed singly 8 in. to 12 in. apart. Planting is done with a dibble. The sets consist of runners which resemble very much the underground stems of the perennial Sunflower, and the crowns of the old plants which have been taken up the previous season. The runner and the crown sets are usually planted alternately, and then covered to a depth of 1 in. to 2 in. with soil.

A wet time after planting usually results in many of the sets rotting and failing to grow, the best results being obtained if the weather continues dry for the first 3 or 4 weeks after planting.

During the season the plants require no attention except keeping free from weeds and cutting down the old stems in the autumn or winter. For the first two years the land is cropped between the ridges with early potatoes, cauliflowers, carrots and other kinds of vegetables. The fourth year the plants are usually lifted, this taking place during October and November. The labour bill in lifting is a heavy item, rarely less than £60 an acre.

Trenches have to be dug 3 to 4 ft. deep along the sides of the rows so that the entire root may be obtained. When removed they are trimmed of the small roots and runners, the crowns removed for future planting, and the roots tied into bundles weighing 3½ lb. each. These are collected and made into bales weighing 1 cwt., and in this condition they are sent to the different markets. The crowns are sorted over, the old or original crown that was planted being cut away, and these together with the small roots are known as offal, and are sent to manufacturing chemists and made into various liquorice preparations. The young crowns together with the runners are retained for planting the next season. The price of the liquorice root varies considerably. At £5 or even £6 per cwt. it is said to yield no profit. A fair price is considered about £8, but during the War much higher prices were realised. For the offal only about 8s. a cwt. is obtained. The weight of baled root obtained per acre is about 2 tons, and of the offal only a few cwt.

It may appear that at £7 to £8 per cwt. liquorice growing is a very profitable crop, but against this must be set the high cost of planting, the interval of four years before any returns are obtained, except from the intercropped vegetable crops the first two years, and the heavy expenses of lifting and trimming the roots. And another point is that there is only a limited demand and this appears to be getting less and less each year.

The question of growing the liquorice root for extraction of the liquorice of commerce, of which thousands of tons are annually imported, has sometimes been raised, but when it is pointed out that imported liquorice, not the root, is on offer at present at £5 a cwt., it will be seen that it is impossible for the English grower to compete since he grows at a loss when he obtains that price for the root. The difference can be better realised when it is stated that 1 cwt. of the root only yields 30 lb. of liquorice.'

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THE FIRST YEAR'S WORKING OF THE SEEDS ACT, 1920.

II.

Seed Potatoes.—One of the new features of the Seeds Regulations, 1921, was that in the case of a sale or exposure for sale of seed potatoes, a statement had to be delivered to the purchaser (or exhibited alongside the potatoes when exposed for sale) containing particulars as to the class, variety, size and dressing of the potatoes. As regards the statement of variety, it was laid down that this should not be taken to be incorrectly stated if it were true of 97 per cent. of the total quantity sold or exposed for sale, or, in other words, that an error of 3 per cent. would be allowed. On representations being made by the seed potato trade that it was impossible, during the first year that the Regulations were in operation, to limit the possible error to 3 per cent., the Ministry issued a General Licence authorising the standard of purity to be reduced to 95 per cent. for the 1921-22 season only. In the amended Seeds Regulations, 1922, the sale of a quantity of seed potatoes of less than 97 per cent. purity is authorised provided they are declared to be of "mixed varieties."

The sale of seed potatoes is similar to that of packeted seed, inasmuch as it is to a large extent undertaken during a few weeks only in the year by a number of persons whose ordinary business has no connection whatever with the seed or

nursery trades. This fact makes it very difficult for the Ministry to bring to the notice of the various sellers their responsibilities under the Act, and still more difficult to detect evasions. A large number of establishments have, however, been visited, and the usual explanations and warnings given. These visits, combined with propaganda work which the Ministry is undertaking in order to make known the requirements of the Seeds Act, have already had very satisfactory results.

The principal errors made by vendors of seed potatoes have been as regards the "size and dressing." This term is described in the Regulations as meaning "the size of the mesh (exclusive of the thickness of the wire) of the riddles through and by which, respectively, the potatoes may be passed and retained." The Regulations concede in the case of seed potatoes sold "as grown" that the size of the mesh of the top riddle need not be stated. There have been a large number of cases in which a substantial proportion of the potatoes were much too large to pass through a mesh of the size declared.

Farmer to Farmer Sales.—One of the greatest difficulties in connection with the administration of the Act is to bring home to farmers their responsibilities when selling seeds to other farmers. When selling seed corn or any of the scheduled kinds of seeds intended for sowing, such as red clover, tares, etc., they are in precisely the same position as the seedsman, and are bound to supply the same guarantee. Thus a farmer selling a sack of home-grown clover seed to a neighbour for sowing should, in the first place, have a sample tested at an Official Seed Testing Station, and supply the buyer with a copy of the result not later than the date on which the seed is delivered.

Various methods have been adopted to bring to the notice of the farmer the benefits which he derives from the operations of the Act when he is a buyer of seeds, and the responsibilities which are his when he is a seller. With the welcome assistance of the National Farmers' Union and other farmers' organisations, a large number of leaflets have been distributed, paragraphs have been inserted in the country newspapers from time to time, and the co-operation of the local Agricultural Education Authorities and the Agricultural Colleges has been enlisted. In referring to the number of farmers' samples sent for testing to the Official Seed Testing Station, the Chief Officer of the Station in his report for the season 1920-21 says:—"In any county the number of farmers using the Station appears to be in direct

proportion to the activities in this connection of the County Agricultural Organiser."

One of the most hopeful pieces of propaganda work in this connection during the past season has been the series of lectures on the Seeds Act given by the Ministry's inspectors at meetings which it was possible to arrange, thanks to various Branches of the National Farmers' Union, and the Local Education Authorities. In Wales the total number of meetings of this kind attended by the Ministry's Seeds Inspector was 28, spread over eleven different counties. The attendance of farmers at these Welsh meetings was approximately two thousand, but as reports appeared in most of the county papers circulating amongst the farming community, the actual number of farmers reached must have been far greater.

Prosecutions.—Legal proceedings for infringements of the Seeds Act have been taken in four cases during the season 1921-22.

The first case was heard at Harrogate where a firm of seedsmen in the town were charged with making a false statement under the Act in respect of a quantity of onion seed. The germination of the seed in question was stated to be not less than the minimum percentage authorised by the Seeds Regulations, 1921, *i.e.*, 60 per cent., whereas the actual germination was found on an official test to be only 5 per cent. The Bench imposed a fine of £1 1s. and £3 3s. costs.

The second case was in respect of a similar charge against a seedsman at Knaresborough who exposed parsnip seed for sale with a declaration that the germination was at, or above, the authorised minimum, *i.e.*, 45 per cent., but which was shown to be only 27 per cent. The Bench inflicted a fine of £1 and £1 1s. costs.

The third case was heard at Abergavenny, and the defendant pleaded that the seed which was the subject of the prosecution was old and not intended for sale. The Bench decided that, as there was some doubt as to the seeds being exposed for sale, the case should be dismissed, but told the defendant that in their opinion he was to blame for having such old seed on the premises.

The fourth case was heard at Peterborough, the charge being failure to deliver to the purchasers, in the case of two separate sales of seed potatoes, the necessary statement as to class, variety, size and dressing. A conviction was obtained, and a

fine of £1 and costs inflicted in both cases. The costs amounted to £10 in the one case and £5 in the other.

Amendments of Seeds Regulations.—In the light of the experience gained since the Seeds Regulations, 1921, came into operation on the 1st August, 1921, a number of minor amendments were recently agreed to by the Ministry in consultation with representatives of the various interests concerned. These alterations have been incorporated in a new set of Regulations entitled the "Seeds Regulations, 1922," which came into operation on the 10th August last, superseding the previous Regulations.

Apart from amendments of a purely drafting nature, the alterations have the effect of:—

(1) Specifically excluding lawn grass seeds from the requirements of the Regulations;

(2) Withdrawing the necessity for stating the percentage of pure germinating seed or "real value" in the case of grass or clover seed;

(3) Allowing alsike clover and white clover, when grown together, to be treated, for the purposes of the Regulations, as one seed, provided they are declared as having been grown together;

(4) Requiring, for the purpose of testing, the sprouted grains of cereal seeds not to be treated as an impurity, that is to say they are not to be picked out of the sample put up for the germination test;

(5) Reducing the authorised minimum percentages of germination in the case of broccoli and cauliflower from 65 to 60; and

(6) Authorising the sale of seed potatoes, the variety of which is less than the standard purity of 97 per cent., provided they are specifically described as being of mixed varieties.

Copies of the Seeds Act, 1920, and of the Seeds Regulations, 1922, may be obtained through any bookseller, or direct from H.M. Stationery Office, Imperial House, Kingsway, W.C., price 3d. each.

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NOTES ON MANURES FOR DECEMBER.

SIR JOHN RUSSELL, D.Sc., F.R.S.,
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Does Manuring pay? A further Example.—In last month's notes the question was raised whether manuring pays, and the answer was given that it does when it is properly carried out. Assuming that a farmer can grow a crop at all at present prices he will make more out of a good crop than of a poor one. It is quite fallacious to suppose that under-production on British farms would help farmers by forcing up prices or in any other way; it would simply result in more imports. Nor is there any reason why farmers should despair and give up because of the difficult times through which they are now passing. Last month an instance was given showing that the best return to the farmer is obtained when a bold policy is adopted and the fertiliser dressing is not too stinted.

This is shown by the following experiment on potatoes carried out this season at Rothamsted :—

	Yield per acre.	*Increase due to each additional 1½ cwt. sulphate of ammonia.*
	tons.	*tons per acre.*
10 tons farmyard manure ; phosphates and potash and—		
No nitrogenous manure ...	6·0	—
1½ cwt. sulphate of ammonia	7·5	1·5
3 " " "	9·4	1·9
4½ " " "	9·7	0·3

As in the cases previously quoted, the double dressing of sulphate of ammonia has given more than double the return of the first; 1½ cwt. sulphate of ammonia gave an additional crop of 1½ tons per acre of potatoes, while 3 cwt. gave an additional 3 tons 8 cwt. per acre. Now the price of 3 tons 8 cwt. of potatoes is not yet anything like as low as that of 3 cwt. of sulphate of ammonia, even after the cost of lifting, storing, marketing, etc., is thrown into the account.

The experiment illustrates the undoubted truth that, after a certain point is reached, further additions of fertiliser do not continue to increase the yield of crop at the same rate, although the increase may still be profitable. In the present instance a further 1½ cwt. sulphate of ammonia (making 4½ cwt. in all) gave a further increase of 6 cwt. of potatoes per acre over that given by 3 cwt.: this is a small but by no means negligible

result. Obviously, however, the main effect is produced by the 1½ or 3 cwt. per acre, and further additions of manure might well prove to be unprofitable.

The evidence indicates that there are two distinct sets of maximum returns for successive increments of manures:—a maximum increment of crop which is given not necessarily, and probably not usually, by the first, but by the second or some subsequent increment of manure; and a maximum of profit which may be obtained with some particular increment of manure.

Effect of Potassic Fertilisers on Clover.—One of the most striking results at Rothamsted this year was the effect of potassic fertilisers in increasing the yield of clover in a pure red clover ley. The plant to begin with was poor; it was kept over from the 1920 sowing and left to stand after being cut in 1921 because the young seeds of that year completely perished in the drought. It was sufficiently good to save under the circumstances, but was not very vigorous. The results of treating it with fertilisers showed that slags of various kinds gave no improvement, but potassic fertilisers improved the yield. The results were:—

	Clover hay: cwt. per acre.
No added manure	17·0
Basic slag	17·0
Sulphate of potash...	23·2

an increase of over 6 cwt. of clover hay per acre for an addition of 1 cwt. of sulphate of potash.

Apparent Failure of Basic Slag on Grass Land.—Cases have recently been reported in which farmers applied basic slag to grass land last winter, but have seen no result. The past season was not very favourable to slag, and in the Rothamsted experiments slag gave very little result. The cold spring was unfavourable to growth in many districts, and it was not till the end of May that the grass began to make much growth: it then came on with a rush. In these circumstances the slag does not seem to have exerted its effect, and only one of the various samples tested in the field at Rothamsted gave any marked increase.

There are, however, cases where even in good seasons slag does not act as well as it might be expected to do. Some of these were mentioned in last month's notes: they were cases in which lime was needed before the slag could act. Another possibility is suggested by the clover experiment just mentioned: here slag by itself was without action in increasing the growth of clover, though potash was effective. It is possible, therefore, that some

of the cases of apparent inertness of slag may be due to shortage of potash. It has long been known that this happens on light soils, though here the increased yield of hay or of grazing vegetation may be too small to justify the expenditure incurred in securing it; but it has not before been suspected that a shortage of potash might occur on heavy soils, and this possibility is therefore being tested at Rothamsted during the coming season.

Does Superphosphate use up the free Lime in a Soil?—A correspondent asks the following question:—If a sample of superphosphate contains a certain amount of combined lime can it be assumed that an equal amount will be withdrawn from the reserves in the soil when the superphosphate reverts, as it is supposed to do, directly it is put on the land?

The question is difficult to answer because the changes occurring when superphosphate is added to soil, and again when it is taken up by the plant, are very complex and cannot be set out in any simple way. Undoubtedly the superphosphate becomes insoluble and to this extent might be expected to combine with and therefore withdraw from the soil a certain proportion of its basic material including the free lime; but the amount withdrawn is really small, even if one supposed that the whole burden falls on the lime. Only a fraction of the total lime is involved in any case; much of it is in the form of calcium sulphate which does not react with lime; the active part is the mono-calcium phosphate, and the lime with which this can react does not amount to more than 5 or 6 per cent. of the weight of the superphosphate, according as the sample is of 26 or 30 per cent. strength; in other words, a dressing of 2½ cwt. of superphosphate would withdraw from the soil less than 15 to 20 lb. of lime per acre. It is improbable, however, that all the burden falls on the lime in the soil.

Town Refuse as Manure: further Instances.*—A test of town refuse has been made this season at Rothamsted. Three plots were laid out on the mangold field: one was given London stable manure at the rate of 10 tons per acre, and the other two received town refuse sent from Hampstead by the contractors. In addition artificials were supplied at the rate of 3 cwt of superphosphate and a mixture of muriate and sulphate of ammonia equivalent to 3 cwt. of sulphate of ammonia. No differences were observed between the three plots at any time, and in the end the yields of roots were equal within the errors of experiment, there being 22 tons per acre on the straw manured plots and 23 tons

* See this *Journal*, November, 1922, p. 685.

on the plots receiving town refuse. The crop is not large and the season was not particularly favourable to farmyard manure. The result is nevertheless interesting. It still remains to be determined whether the effect of town refuse in the second and later seasons is equal to that of farmyard manure.

Some further analyses of town refuse are as follows:—

	Letchworth *per cent.*	*Colwyn Bay* *per cent.*
Mineral matter	41·34	42·4
Organic matter	32·49	19·05
Moisture	24·14	38·56
Nitrogen	0·33	0·78
Phosphoric acid (P_2O_5)	0·33	1·26
Equal to Tricalciephosphate ...	0·72	2·75
Calcium oxide	—	2·42
Calcium carbonate	6·87	—
Oxides of iron and alumina ...	7·87	10·20

Prices of Artificial Manures.

Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	Price per ton				
	Bristol	Hull	L'pool	Ldn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	..	...	13. 0	13. 7	17. 3
Sulphate of Ammonia, ordinary (A. 25¼ per cent.)	15.10*	15.10*	15.10*	15.10*	(N)14.11
,, ,, neutral (A. 25¾ per cent.)	16.13*	16.13*	16 13*	16 13	(N)15.8
Kainit (Pot. 12½ per cent.)	...	...	2.12	2. 7	3. 10
French Kainit (Pot 14 per cent.)	2 10	2. 1		2.12	3. 9
Sylvinite (Pot. 20 per cent.)	...	...	...	3. 5	3. 3
Potash Salts (Pot. 30 per cent.)	...	...	...	5. 2	3. 5
Muriate of Potash (Pot. 50 per cent.) ...	...	10.10	8.10	9. 5	3. 8
Sulphate of Potash (Pot. 48 per cent.) ...	...	11.15	12. 0	12. 0	5. 0
Basic Slag (T.P. 30-32 per cent.)	3.17§	..	...	4. 2§	2. 8
,, ,, (T.P. 24-26 per cent.)	...	3. 1§		...	...
,, ,, (T.P. 20-22 per cent.)	2.15§	2.13§	2.15§	2.15§	2. 7
,, ,, (T.P. 16-18 per cent.)	2. 5§	..	2.11§	2.13§	3. 2
Slag Phosphate (T.P. 60 per cent.)	6. 7§	...	.	6.17§	2. 3
,, ,, (T.P 50 per cent.) ...	...	...	6.12§	5.17§	2. 4
,, ,, (T.P 40 per cent.)	4. 7§	...		4.17§	2. 5
Superphosphate (S.P. 35 per cent.)	4. 9	...	4.15§	4. 5	2. 5
,, (S.P. 30 per cent.)	3.16	3.10	4. 2§	3.15	2. 6
Bone Meal (T.P. 45 per cent)	9 10	9 10†	9. 0	9. 0	...
Steamed Bone Flour (T.P. 60 per cent.) ...	8.10†	8. 5†	8. 5	7. 7	...
Fish Guano (A. 9-10, T.P. 16-20 per cent). ...	12 15	...	12. 5	12. 7	...

Abbreviations: N.= Nitrogen; A.= Ammonia; S.P.= Soluble Phosphate; T.P.= Total Phosphate: Pot.= Potash.

* Delivered in 4 ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

§ Prices include cost of carriage from works to town named. Cost to purchasers in other districts will be greater or less according to the distance of different purchasers from the works.

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NOTES ON FEEDING STUFFS FOR DECEMBER.

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How to use the Feeding Stuffs Table.—Several correspondents have asked for information as to the method of using the table given every month in these notes, and it may be useful to repeat here notes that have been given at different times in previous issues.

It will be noted that the table contains two sections. The first deals with the actual current wholesale prices at markets, and the second gives an estimate of the values for feeding on the farm home-grown feeding stuffs.

Market Prices.—When a farmer feeds a purchased cake or feeding stuff to stock, a certain amount of the nitrogen, potash and phosphates in that feeding stuff finds its way into the urine or the dung and is used for manuring the ground. A feeding stuff when purchased therefore has a manurial value as well as a feeding value, so that in comparing the feeding values of any purchased cakes we have to take into consideration the manurial value. In the table given, the manurial value of the cake or feeding stuff is first assessed from the current prices of artificial manures and this figure is subtracted from the price per ton of the feeding stuff. This gives the cost of the food value per ton of the feeding stuff. Now the starch equivalent figure given in the fifth column of the table gives as accurate a figure of the feeding value of the feeding stuff as is required for all practical purposes. The cost of the food value is therefore divided by the starch equivalent figure, and this gives the cost per food unit. The cheapest feeding stuff is the feeding stuff which is the cheapest per unit of starch equivalent. Thus, in this month's table wet porter grains prove the cheapest feeding stuff available where local conditions allow its ready transport. American oats are also much cheaper than Canadian, Scotch, or English oats.

Several correspondents have mentioned from time to time that the prices given in this table differ from the prices current on local markets. This is admittedly so, and for this reason the method of working out the unit value of a feeding stuff is given in the footnote to the table. This enables a farmer to

DESCRIPTION.	Price per Qr. s.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv. s.	Price per lb. Starch Equiv. d.
Wheat, British	45/6	504	10 2	0 18	9 4	71·6	2/7	1·38
Barley, British Feeding	32/6	400	9 2	0 14	8 8	71	2/4	1·25
„ Canadian No. 3 Western	35/–	400	9 16	0 14	9 2	71	2/7	1·38
Oats, English White	36/–	336	12 0	0 16	11 4	59·5	3/9	2·01
„ , Black & Grey	31/–	336	10 7	0 16	9 11	59·5	3/3	1·74
„ Scotch White	38/–	336	12 13	0 16	11 17	59·5	4/0	2·14
„ Canadian No. 2 Western	34/–	320	11 18	0 16	11 2	59·5	3/9	2·01
„ „ No. 2 Feed	31/6	320	11 0	0 16	10 4	59·5	3/5	1·83
„ American	29/–	320	10 3	0 16	9 7	59·5	3/2	1·70
„ Argentine	30/–	320	10 10	0 16	9 14	59·5	3/3	1·74
Maize, Argentine	42/–	480	9 16	0 15	9 1	81	2/3	1·20
„ American	41/–	480	9 11	0 15	8 16	81	2/2	1·16
„ South African	41/–	480	9 11	0 15	8 16	81	2/2	1·16
Beans, English Winter	51/–	532	10 15	1 17	8 18	67	2/8	1·43
„ Rangoon	8/6	112	8 10	1 17	6 13	67	2/–	1·07
Peas, English Dun	60/–	504	13 7	1 13	11 14	69	3/5	1·83
„ „ Maple	85/–	504	18 18	1 13	17 5	69	5/–	2·68
Rye, Home-grown	34/–	504	7 11	0 18	6 13	71·6	1/10	0·98
Millers' offals—								
Bran, British	—	—	6 10	1 12	4 18	45	2/2	1·16
Broad Bran	—	—	7 10	1 12	5 18	45	2/7	1·38
Fine middlings (Imported)	—	—	9 7	1 6	8 1	72	2/3	1·20
Coarse middlings (British)	—	—	8 12	1 6	7 6	64	2/3	1·20
Pollards (Imported)	—	—	7 5	1 12	5 13	60	1/11	1·03
Barley Meal	—	—	11 0	0 14	10 6	71	2/11	1·56
Maize „	—	—	10 10	0 15	9 15	81	2/5	1·29
„ Germ Meal	—	—	10 10	1 2	9 8	85·3	2/2	1·16
„ Gluten-feed	—	—	9 10	1 12	7 18	75·6	2/1	1·12
Locust Bean Meal	—	—	8 15	0 11	8 4	71·4	2/4	1·25
Bean Meal	—	—	13 10	1 17	11 13	67	3/6	1·87
Fish „	—	—	14 0	5 1	8 19	53	3/5	1·83
Linseed „	—	—	21 2	1 16	19 6	119	3/3	1·74
„ Cake, English (9°/₀ oil)	—	—	14 0†	2 5	11 15	74	3/2	1·70
Cottonseed „ English (5°/₀ oil)	—	—	7 15	2 1	5 14	42	2/9	1·47
„ „ Egyptian (5°/₀ oil)	—	—	7 15	2 1	5 14	42	2/9	1·47
Soya Bean Cake (6% oil)	—	—	12 5	3 3	9 2	69·1	2/8	1·43
Coconut Cake (6°/₀ oil)	—	—	9 0	1 16	7 4	73	2/–	1·07
Palm Kernel Meal (1½-2°/₀ oil)	—	—	5 12	1 8	4 4	71·3	1/2	0·62
Feeding Treacle	—	—	4 10	0 10	4 0	51	1/7	1·85
Brewers' grains, dried, ale	—	—	7 15	1 8	6 7	49	2/7	1·38
„ „ „ porter	—	—	7 5	1 8	5 17	49	2/5	1·29
„ „ wet, ale	—	—	1 5	0 11	0 14	15	–/11	1·49
„ „ wet, porter	—	—	0 18	0 11	0 7	15	–/6	0·27

† At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of October and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose coconut cake is offered locally at £10 per ton. Its manurial value is £1 16s per ton. The food value per ton is therefore £8 4s. per ton. Dividing this figure by 73, the starch equivalent of coconut cake as given in the table, the cost per unit of starch equivalent is 2s. 3d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·21d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

ascertain for himself the cheaper of any two feeding stuffs offered him, and he can then decide whether the difference in condition and quality of sample justifies the difference in the price asked. The chief object in view in publishing this table is to draw attention to the kind of feeding stuffs which are on offer at low values and likely to prove an economical purchase to the farmer.

Farm Values.—The second section of the table deals with the estimated value of home-grown produce on the farm. In this case, the reader should look at the price per ton of the feeding stuff and compare it with the price per ton offered him for sale. If the price per ton offered for his home-grown products shows a profit after allowing for cartage charges and buying in fresh feeding stuffs, it will be an advantage to sell off these products and buy in feeding stuffs. If, on the other hand, such a procedure shows a loss, it will prove a more profitable transaction to feed off the home-grown product rather than sell it. It will be noted, for instance, that wheat, oats and barley still show a distinct margin of profit if sold off rather than kept for feeding, except in the case of middlings which is distinctly dearer than the farm value of wheat. In the case of barley, too, it would be an unprofitable transaction to sell off barley at £9 2s. a ton and buy in barley meal at £11 a ton.

FARM VALUES.	Value per Ton on Farm. £ s.	Manurial Value per Ton. £ s.	Food Value per Ton. £ s	Starch Equivalent per 100 lbs.	Value per unit S.E. s. d.	Market Value per lb. S.E. d.
Wheat	8 13	0 18	7 15	71·6	2/2	1·16
Oats	7 5	0 16	6 9	59·5	2/2	1·16
Barley	8 8	0 14	7 14	71·0	2/2	1·16
Potatoes	2 3	0 4	1 19	18·0	2/2	1·16
Swedes	0 18	0 3	0 15	7·0	2/2	1·16
Mangolds	0 16	0 3	0 13	6·0	2/2	1·16
Good Meadow Hay	4 16	0 16	4 0	31·0	2/7	1·38
Good Oat Straw	2 12	0 8	2 4	17·0	2/7	1·38
Good Clover Hay	5 7	1 4	4 3	32·0	2/7	1·38
Vetch and Oat Silage	2 2	0 9	1 13	14·0	2/4	1·27

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THE Ministry has decided to extend the scope of its Register of Dairy Cows by including additional Sections as indicated below.

Register of Dairy Cattle.

These additions will, it is hoped, enhance the usefulness and value of the Register.

The Volume No. VI., for the year ending 1st October, 1922, will accordingly be known as the Ministry's "Register of Dairy Cattle," and will comprise:—

Section I.: Dairy Cows—

(*a*) With certified milk records of prescribed yields (*i.e.*, 8,000 lb. for one year, or 6,500 lb. average for two or more consecutive years) for the year ending 1st October, 1922;

(*b*) In respect of which Certificates of Merit have been awarded.

The object of Certificates of Merit is to encourage Dairy Farmers to retain in their herds cows which, in addition to being heavy milkers, are also regular breeders. Certificates of Merit will be issued on application from owners in respect of cows which have been entered in the Register for three consecutive years, and which during those three years have yielded not less than 24,000 lb. of milk and calved not less than three times.

Section II.: Pedigree Bulls for Dairy Herds—

(*a*) Whose dams and sires' dams have been entered or accepted for entry in the Ministry's Register of Dairy Cattle; or

(*b*) Having two or more daughters entered or accepted for entry in the Ministry's Register of Dairy Cattle.

The object of this Section of the Register is to encourage dairy farmers to use pedigree bulls bred from milking strain, or those whose female progeny have proved to be satisfactory dairy cows, and also to provide dairy farmers with a list of such bulls, together with the names and addresses of their breeders and owners.

The Ministry desires to direct attention to the fact that the price of Volume V. of the Register of Dairy Cows for the year ended 1st October, 1921, which will be ready shortly, has been reduced to 2s. 6d. net, post free. Applications for copies should be addressed to the Secretary, Ministry of Agriculture and Fisheries, Whitehall Place, S.W.1. Remittances should be by Postal Order, Money Order or Cheque, made payable to the Secretary, Ministry of Agriculture and Fisheries, and crossed "Bank of England."

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Prices of Apples.

RECENT observations concerning the prices obtained by growers for dessert apples when properly graded and packed, in comparison with similar fruit marketed in the more usual way, have brought out some facts which illustrate the profitableness of the better method.

A record crop of Worcester Pearmains, grown in Gloucestershire, was sent to Manchester and Birmingham markets in the British Standard boxes containing 40 lb. of fruit. The average price per box including first and second grade fruit so marketed was 15s.

Some pots of the same variety and quality, but ungraded and loose, were sent to the Cheltenham Fruit Market in the ordinary way. The price realised for these was 6s. 8d. per 56-lb. pot, or 1¾d. per lb., compared with 4½d. per lb. obtained in the other markets for the boxed fruit.

Even when the supply of box wood had run out and a consignment was sent in 56-lb. wickers, *well graded and properly packed*, to the salesman who had sold the boxes, the price continued to be 4½d. per lb., or 21s. per pot. The salesman pointed out that the excellent prices were maintained solely because the grower's reliable packing was already known in the market.

* * * * * *

Small Holdings in Essex.

IN connection with the Farm Competitions organised by the Essex Agricultural Society, with a view to improving cultivation and stimulating production on farms and small holdings in Essex, several prizes, given by the Hon. E. G. Strutt, C.H., President of the Society, were offered this year for the best cultivated County Council Small Holdings. There would appear to have been keen competition for the prizes. Thirty-three smallholders entered in the class for holdings under 15 acres, and forty-one for that limited to small holdings over that acreage. Five prizes were awarded in each class, and in addition thirteen entrants who came just below prize merit were "commended," one being "highly commended."

In the course of some general remarks on the holdings inspected and on the work of the Small Holdings Committee, the judges made the following observations:—

"With regard to the land acquired by the Committee for Small Holdings, we were most favourably impressed with its quality and suitability for the purpose. In these respects the

land far exceeded our expectations, and was indeed a most pleasant surprise, as we had often heard disparaging reports of it. This remark has special emphasis in the case of the Boxted, Beaumont, and Eastwoodbury Settlements, where the land appeared to us to be admirably suited for the purpose for which it was purchased.

"Bearing in mind the fact that it would certainly be some of the best cultivated holdings which would be entered for competition, we must say that we were pleased with many of the holdings we inspected. In some cases where knowledge, ability, industry, and physical strength are all combined in a man and his family, we saw the most gratifying and satisfactory results, though at the cost of strenuous labour and long hours of toil, such as few farm labourers would care to put in."

There is no doubt that these competitions must have a very beneficial effect on the cultivation of holdings throughout the county, and it is very gratifying that experienced farmers should be able to report so favourably on the results of the efforts of the Small Holdings Committee and their tenants.

* * * * * *

Market for Poultry Feathers.

POULTRY-KEEPERS who have large stocks are advised to keep in mind the possibility of marketing poultry feathers. From information which the Ministry has obtained from various sources, it appears that large quantities of poultry feathers are annually imported from China, United States, France, and Portugal, and that some are exported from this country to the Colonies. The weights and values of these imports in 1913 were 45,016 cwt. at £159,366; in 1919, 52.468 cwt. at £284,791; and in 1920, 79,115 cwt. at £587,516.

English feathers are usually regarded in the Trade as inferior to the best imported kinds on account of the fact that when marketed they are not so free from dirt and impurity. Feathers for sale should be clean, and should be graded both as regards colour and quality as they are plucked. White and light-coloured feathers are the best, and fowl feathers should be kept separate from those of ducks and geese, as the feathers of the latter are of much greater value. The different kinds might be loosely packed in muslin or scrim bags and hung up in a dry place out of reach of any ground damp. The quill feathers, which are of less value, should never be mixed with the smaller feathers.

Consignments of 5 cwt. and upwards are easily disposed of to feather merchants, and smaller quantities can often be sold privately, and possibly better prices obtained than the merchant will give. A list of names of dealers in feathers can be had on application to the Ministry, 10, Whitehall Place, S.W.1.

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Probable Yield of Potato and Root Crops.

Potatoes.—At the end of October probably about three-fourths of the potatoes had been lifted in the country as a whole. Weather conditions had been favourable and the tubers stored in dry condition. The crop is healthy and the tubers mostly large, though there are occasional reports of disease and damage by slugs. Heavy crops will be obtained in all parts of the country except in the north-west, where they are considered about average. The yield per acre was estimated on 1st November at 7 tons per acre, or 1 ton per acre above average, which would give a total production of about 3,920,000 tons in England and Wales against 2,960,000 tons last year.

Roots.—The pulling and storing of mangolds was in progress at the end of October, and in some districts the bulk of the crop had been harvested. Yields well over the average will be obtained in the east and south-east, but in other parts of the country the roots are mostly small and yields somewhat below average are expected in the north and in Wales. Turnips and swedes are rather small in most districts. These crops also have done best in the east and south-east, whilst in the north-west and in Wales under average yields are expected. The yields per acre of both mangolds, turnips and swedes over the whole country are expected to prove about 7 per cent. above average, mangolds being forecasted at rather more than 20 tons and turnips and swedes at slightly over 13 tons per acre. These yields would give a total production of mangolds of 8,500,000 tons against 6,250,000 tons last year, and of turnips and swedes 10,860,000 tons against 6,600,000 tons in 1921.

The appearance of the potato and root crops on 1st November indicated probable yields per acre as shown in the table below. These forecasts, however, are not based on detailed inquiries such as are carried out in connection with the final estimates of yield issued after harvest, and therefore have not the same degree of accuracy. It should also be borne in mind that the

actual yields may be affected by weather conditions after 1st October :—

Counties.	Potatoes. Forecast, 1922. Tons.	Potatoes. Ten Years' Average. Tons.	Turnips and Swedes. Forecast, 1922. Tons.	Turnips and Swedes. Ten Years' Average. Tons.	Mangolds. Forecast, 1922. Tons.	Mangolds. Ten Years' Average. Tons.
Eastern ...	6·9	6·0	13·5	10·3	21·3	16·7
North-Eastern ...	7·8	6·2	12·7	11·0	19·5	17·8
South-Eastern ..	7·3	5·7	14·2	10·9	21·6	18·7
East Midland ...	6·6	5·5	10·6	11·1	18·1	18·1
West Midland ...	7·0	5·8	13·4	13·5	22·6	21·7
South-Western...	6·5	5·5	13·8	12·8	21·5	21·5
Northern ...	6·0	5·2	14·7	12·9	15·1	16·5
North-Western...	6·9	6·8	13·5	16·7	18·6	21·0
North Wales ...	6·4	5·3	11·7	14·6	15·5	17·2
South Wales ...	6·9	5·3	11·5	14·1	15·9	17·0
ENGLAND AND WALES	7·0	6·0	13·2	12·3	20·2	18·7

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Test of Varieties of Fruit for Commercial Purposes.

THE Ministry and the Royal Horticultural Society have set up a Joint Committee to administer a scheme for the official testing of new varieties of fruit for commercial purposes. Under the scheme the Royal Horticultural Society's Gardens at Wisley will serve as the Central Station, at which all varieties will be tested in the first instance. In later years varieties selected as showing merit will be sent for further testing to sub-stations which the Committee hope to establish in various fruit districts throughout the country.

Tests will be confined for the present to hardy fruits—apples, pears, plums, cherries, gooseberries, currants, raspberries, strawberries, etc., and also nuts.

The Committee is now prepared to receive applications for the reception of plants, buds, and grafts sufficient to allow the following number of trees, bushes and plants to be grown of each variety :—

Apples and pears	20 Half standard.
plus	20 Bushes.
Plums, cherries and nuts	10 Half standard.
Currants, gooseberries, raspberries and other berries	20 Bushes.
Strawberries	100 Plants.

Buds or grafts will be worked on approved stocks.

In no circumstances will the central station or a sub-station permit trees, buds or grafts to be taken off the station.

The Committee will, after a consideration of the reports of the recording staff and selected specialists, issue reports in which recommendations of special varieties will be made. No report on a variety will, however, be issued until sufficient time has elapsed to enable a fair test to be carried out.

The Committee for this purpose consists of :—

Professor W. Bateson, F.R.S. (Chairman).

Mr. W. G. Lobjoit, O.B.E., J.P. Mr. H. V. Taylor, M.B.E., B.Sc. Mr. J. C. F. Fryer, M.A. Professor B. T. P. Barker, M.A. Mr. G. W. Leak.	Appointed by the Ministry of Agriculture.
The Chairman of the Wisley Committee. The Director of Wisley. The Chairman of the Fruit Committee. Mr. E. A. Bunyard. Mr. Cuthbert Smith.	Appointed by the Royal Horticultural Society.

All communications concerning the scheme should be addressed to The Director, Royal Horticultural Society Gardens, Wisley, Ripley, Surrey.

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Serum Treatment for Swine Fever.

THE Ministry announces that as from 1st January, 1923, it will no longer be able to supply Anti-Swine-Fever Serum for the treatment of pigs in order to protect them from infection of Swine Fever.

This material has hitherto been supplied by the Ministry free of charge, to owners of pigs in cases suitable for the adoption of this method of preventing the spread of disease to apparently healthy pigs on premises where swine fever has broken out. The method is only relatively inexpensive, and its value depends upon the conditions under which it can be applied in practice. The Ministry has found, however, as the result of experience, that owing to the difficulty of getting in touch with outbreaks before infection has made considerable inroads among the stock, successful results in connection with preventive treatment are greatly interfered with. Having regard to this and to the necessity for economy, it is considered advisable to discontinue serum treatment until such time as a safe method of giving permanent, in place of temporary, immunity has been worked out.

The Ministry will be prepared, through its Inspectors, to advise owners of pigs concerned in an outbreak, whether their individual

cases are more favourable than usual, for the application of serum as a temporary preventive, and will also advise them how the serum can be purchased on the market if desired.

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Importation of Onion and Leek Seed.

THE importation of onion and leek seed into this country is subject to the provisions of the Destructive Insects and Pests (Importation of Onion and Leek Seed) Order, 1922, and all consignments should be inspected in the country of origin before shipment, and certified to be free from disease.

Large quantities of this seed are imported from the United States, and as a result of representations made by the Controller of Horticulture during his recent visit to Washington, it is understood that the American authorities propose to arrange for the examination, while growing, of onion and leek crops intended for the production of seed for export. It is probable that the American authorities will refuse to grant certificates for seed from crops which have not been inspected whilst growing, and importers should therefore take immediate steps to warn their growers in America to ask for the inspection of onion and leek crops now being grown for the production of seed for export to this country.

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Conciliation Committees in Agriculture.

THE following further agreements have been made by Conciliation Committees during the past month:—

Area.	*Period.*	*Details.* *Age.*	*Details.* *Wage.*	*Remarks.*
Cheshire -	- 24th Oct., 1922, to 30th April, 1923	21 & over	32/- for guaranteed week of 54 hrs. Overtime 9d. per hr.	Proportionate rates for male workers under 21 years.
Derby -	- 1st Oct., 1922, to 31st Dec., 1922	do.	7d. per hr. on weekdays and 9d. per hr. on Sundays	—
Devon -	- 30th Oct., 1922, to 31st Dec., 1922, and onward to Lady Day, 1923, unless notice of revision is given by either side	do.	30/- for week of 50 hrs. Overtime 8d. per hr. on weekdays and 10d. per hr. on Sundays	Proportionate rates for male workers under 21 and special rates for female workers. The overtime rates operate until Lady Day, 1923

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Area.	Period.	Details. Age.	Details. Wage.	Remarks.
Lancs., S.	To 31st Dec., 1922	21 & over	37/6 for week of usual hrs.	—
Lancs., N.	To 31st Jan., 1923	do.	37/6 for week of usual hrs.	—
Lancs., E.	To 30th April, 1923	do.	40/- for week of usual hrs.	—
Loughborough	From 4th Nov., 1922, until a fortnight after notice of cancellation is given by either side	do.	32/- per week of 52 hrs. Overtime 7d. per hr. on weekdays, 9d. per hr. on Sundays	—
Shropshire	From 1st Nov., 1922, to 24th Feb., 1923	do.	7d. per hr. for guaranteed week of 48 hrs. Overtime 7d. per hr. on weekdays, 9d. per hr. on Sundays	Proportionate rates for male workers under 21 years of age
Yorks. East Riding	From 28th Oct., 1922, to 29th Dec., 1922	do.	30/- per week	Female and children workers 2/6 per day
Cardigan	13th Nov., 1922, to 13th Nov., 1923, but subject to revision in March, 1923, if either side desires	do.	30/- per week of 54 hrs. in summer and 50 hrs. in winter	Proportionate rates for male workers under 21 years of age
Carnarvon	From 13th Nov., 1922, to 13th May, 1923	do.	33/- for week of 61 hrs. (including Sunday) to special classes of workers. 30/- for 50 hrs. with overtime at 7d. per hr. on weekdays and 8d. per hr. on Sundays for other workers	Proportionate rates for male workers under 21 years of age
Denbigh and Flint	—	do.	33/- for week of 61 hrs. for stockmen and carters; 27/- for week of 50 hrs. for other male workers	—

The Committee for the Holland division of Lincolnshire also agreed to extend the period of operation of their last agreement until the 8th November, 1922.

Full particulars of the agreements for any particular area will be furnished on application to the Ministry.

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AGRICULTURE ABROAD.

AGRARIAN LEGISLATION IN EUROPE—EXPENDITURE OF THE U.S.A. DEPARTMENT OF AGRICULTURE—APPROPRIATIONS FOR AGRICULTURE IN CANADA—DAIRYING IN NOVA SCOTIA—WEEDS IN MANITOBA — TIMBER SEASONING INVENTION — AGRICULTURAL WAGES IN U.S.A.

New Agrarian Legislation in Central Europe.

THE issue of the "International Labour Review" for September contains a very interesting survey of post-war agrarian legislation in Central Europe. The main purpose of the reforms is stated to be the democratic ownership of land, to be attained by dividing up the great estates and by strengthening peasant proprietorship. The land required for the purpose is acquired by different methods. In Germany, Austria, and Hungary, land belonging to or purchased from voluntary sellers by the state (under rights of pre-emption) is used for creating small farms. Should this means be insufficient for the purpose of reform a strictly limited right of expropriation can be sanctioned. In Czecho-Slovakia, Poland, Rumania and Lithuania, large-scale ownership as such is rejected and the new reform legislation is based on the principle that this class of ownership should be suppressed. There is in consequence no question of acquisition from voluntary sellers, but the maximum areas which can be held by individuals are fixed, according to the nature of the land, and expropriation of the rest is insisted on by the terms of the various Acts. In Esthonia and Latvia the properties subject to expropriation are not decided by maximum areas but are those belonging to a certain class of proprietors. The so-called "estates of the nobles" are to be totally expropriated. The method of compensation for expropriation has not yet been decided in these two states, but in the other countries special arrangements have been made for a full or partial payment by way of compensation (either in cash or in government stock), the valuations to be made generally on a pre-war basis.

The cultivation of estates in their present form is, as a rule, permitted by the new legislation, only when carried on by public institutions, such as agricultural schools or experimental stations, or similar undertakings, or when agricultural co-operative societies are the owners. In several agrarian laws the

co-operative cultivation of estates is expressly mentioned as one of the purposes of the reforms. While it is intended to parcel out expropriated lands to increase the size of already existing small holdings, the principal aim is invariably the creation of flourishing new small holdings. In introducing regulations as to the maximum size of the holdings, it is the hope of each state to create undertakings which will be independent both from the economic and social points of view. The dimensions fixed by each country vary according to the purpose of the holding and the nature of the land.

The persons entitled to acquire land set aside for purposes of agrarian reform embrace the following classes:—(1) Ex-service men, disabled ex-service men capable of work, and the dependents of soldiers fallen in the war; (2) Workers employed on the expropriated estates; (3) Other landless inhabitants of rural districts; (4) Former employees in the service of the State, in public service, and disabled ex-service men incapable of full work.

Almost all countries admit the preferential claims of persons in class (1) by which they are able partially to solve the problem of the ex-service man; socially by providing him with a means of livelihood, and financially by relieving the country of pensions obligations.

The general methods of assisting settlers to acquire land are either by some scheme for the granting of rent-titles under an authorised deed of transfer, which provides for the payment of a fixed annual rent (either in money or in kind) by the settler to the former owner, without the payment of any initial sum down, or by the establishment of settlement funds or rural banks, regulated by the government, for the purpose of granting loans. The principle that the settler shall not become complete owner of the land is contemplated in all countries under discussion.

Finally, with a view to maintaining the economic independence of the newly established holdings, special regulations have been laid down to guard against unskilful cultivation. Measures have been taken against the division or mortgaging of the holding, and the personal responsibility of the settler for the efficient working of the holding is clearly defined and can be enforced by the power of the State to re-purchase and dispossess the holder.

It is anticipated that the fundamental character of the new agrarian legislation, as incorporated in the various Acts which

have been passed during the last three years in the countries of Central Europe, will henceforward be maintained in spite of modifications in detail which may be introduced from time to time in the practical application of the reforms.

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Expenditure of the U.S.A. Department of Agriculture for 1922-23.

THE *Experiment Station Record* for July, 1922, contains an account of the appropriations made by Congress for the expenditure of the U.S. Department of Agriculture during the year ending 30th June, 1923. The funds provided by the main Act are $36,770,000 but there are also other funds available for meat inspection, agricultural education, forestry, bonuses on salaries, etc., which bring the total estimated expenditure of the Department up to about $52,000,000 (say, £11,760,000 at the rate of exchange of $4.42 to £1). This is not far from the amount provided for the previous year

An interesting feature of the programme is the formation of a Bureau of Agricultural Economics, under the direction of Dr. H. C. Taylor, by the consolidation of the Office of Farm Management and Farm Economics with the Bureau of Markets and Crop Estimates. The provision for this Bureau amounts to about £804,500, of which, apart from the amounts for statutory salaries and general administrative expenses, £66,000 is allotted for the investigation of improved methods of farm management and practice (£34,000 being for cost of production studies), £106,000 for marketing studies, and £92,000 for the market news service. A number of Acts regulating agriculture and trade are administered by the Bureau, such as the Cotton Futures Act, Grain Standards Act, Packers and Stockyards Act, and the Future Trading Act. The cost of these is put at £300,000, and in addition £37,000 is appropriated for the operation of a market by the Department.

It may be pointed out that a number of duties are carried out by the U.S. Department of Agriculture which fall under other Departments than the Ministry of Agriculture in this country, *e.g.*, inspection of meat and other foods, forestry, and expenditure on road studies. The main divisions of work and the appropriations for them are as follows:—

	£
Animal Industry	1,576,000
Forest Service	1,485,000
Plant Industry	798,000
Chemistry	228,900
Soils	84,000
Entomology	402,300
Biological Survey	197,000
States Relations Service (Agricultural Instruction and allied work)	1,037,500
Agricultural Economics	804,500
Weather	435,600

An interesting item in the estimate for the Bureau of Animal Industry is a sum of £651,000 for the campaign against tuberculosis. In the course of this work during 1921 over 2,000,000 cattle were tested, of which about 3.9 per cent. reacted.

The Bureaux of Plant Industry and Entomology are responsible for heavy expenditure on the eradication of plant diseases and insect pests—*e.g.*, £80,000 and £45,000 respectively for the barberry and white pine blister-rust campaigns, and £40,000 on account of citrus canker. This last disease was thought to be practically eradicated, but the discovery of a new infestation necessitated a supplementary estimate of £34,000 in addition to the £6,000 at first provided. In the case of insect pests £136,000 is allowed for preventing the spread of the gipsy and browntail moths, and £45,000 for combating the European corn-borer.

The budget of the Bureau of Soils includes an item of £16,000 for the investigation of fertilisers and other soil amendments and their suitability for agricultural use.

The appropriations under the States Relations Service, dealing largely with aid to extension instruction in agriculture and domestic economy for boys and girls after leaving school, have been decreased from £1,097,000 to £1,038,000, but there will be other funds available for the work, such as £1,036,000 under the Smith-Lever Act.

The Weather Bureau's budget is increased by £9,000, mainly for its routine observations, but with £700 additional to extend the warnings given to fruit growers regarding impending frosts.

The approved estimates as a whole present few changes from those of recent years. The increased funds are generally for the carrying out of new regulations or for combating particular plant and animal diseases, and show the tendency of the U.S. Congress in late years to vote money for those purposes.

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Appropriations for Agriculture in Canada.

THE agricultural appropriations or estimates of the Dominion of Canada for the year 1922-23 are given in the *Agricultural Gazette of Canada* for September-October, 1922. Provision is made for a total expenditure of \$5,989,000, or at the present rate of exchange approximately £1,345,900, compared with a total of £1,259,600 for 1921-22. The principal headings of expenditure are:—Experimental Farms £297,700, Diseases of Animals £401,100, Live Stock Improvement £238,200, Seed, Feeding Stuffs and Fertilisers Control £61,800, Destructive Insect and Pest Act £53,900, Dairying £39,300, Fruit £35,300.

The estimates of agricultural expenditure in 1922-23 for some of the Canadian Provincial Governments are also shown. For Ontario the total is £370.400, of which £120,600 is allocated to the Ontario Agricultural College. British Columbia will spend £85.300, the largest item in this province being for horticulture, viz., £23,500.

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Encouragement of Dairying in Nova Scotia.

THE passing of an Act by the Nova Scotia Government requiring that on and after 1st May last, all cream delivered, sold or purchased at any creamery or cream station in the country must be graded as to quality, and payment made to the producer upon the basis of that grading, brings under notice the very careful system of encouragement and control exercised by the Provincial Government.

Under the Act for the Encouragement of Dairying passed in 1914, known as "The Dairymen's Act," the Governor in Council was authorised to expend 5,000 dollars per annum in assisting the establishment of creameries, aiding winter-dairying, and maintaining instructors in butter-making. A further sum of 20,000 dollars was later provided for the establishment of demonstration creameries and cheese factories, and the purchase of land necessary for the same. Other sums were authorised for the making good of any deficit in the maintenance of such demonstration creameries and cheese factories.

The Act also provided for the registration of all creamery and cheese factory proprietors and generally ensured that all creameries and cheese factories should maintain a high standard of cleanliness and of sanitary and mechanical methods. Careful records of tests of samples of milk and cream delivered by

producers were to be taken and kept for inspection, as well as delivered to each producer with payments for milk or cream.

The "Dairymen's Association of Nova Scotia" was founded by a later Statute, and an annual grant of 1,000 dollars provided for it. The main object of the Association was "the furthering of the dairy industry of Nova Scotia," and included the holding of an Annual Convention, the fostering of co-operation amongst dairymen, the holding of local dairy meetings, exhibitions of dairy products, and the education of dairymen.

Sufficient has been said to make it clear that the dairy industry in Nova Scotia is progressing upon careful and well-conceived lines. To show how it has extended—and there is room for very considerable extension in the province—the amount of creamery butter produced in 1911 was 275,000 lb., and in 1919, 2,093,000 lb. Even so, in 1918, 68 per cent. of the butter manufactured was still home-made, but the patrons of the creameries are increasing in number annually. The average yield per cow is increasing slowly. The Government Railways provide weekly refrigerator car services for butter, and producers can forward any amount from a 1 lb. package upwards for shipment at Halifax. It is expected that before long Nova Scotia will be able to ship butter in larger quantities to Great Britain and take its share in the market which awaits high-class colonial butters in this country.

* * * * * *

Injurious Weeds in Manitoba.

THE Noxious Weeds Act of the Legislative Assembly of Manitoba, which came into operation last year and takes the place of earlier legislation on the subject, imposes on all Local Authorities the duty of enforcing the destruction, in particular, of several kinds of thistles, and a variety of mustard which infests the corn-producing land of the Province.

The Act provides for the appointment by every Local Authority of at least one weeds inspector, who is to be employed solely in the inspection of lands and the supervision of weed destruction during the summer months. In the case of unorganized territory, similar appointments are made by the Lieutenant-Governor-in-Council.

The onus of destroying the scheduled weeds is placed on the occupier of the land, or, in the case of unoccupied land, on the owner or his agent. The primary duty of an inspector is to see that the work is properly carried out in his district, but in case

of failure to comply with the requirements of the Act, he has power to serve a notice requiring the occupier to cut down and destroy the weeds within a specified period, not exceeding fifteen days. If this warning is ineffective, the inspector may enter on the land and cause the weeds to be destroyed, when the occupier becomes liable to a fine, with a maximum of one year's imprisonment in default of payment.

The Act provides for the cost of destruction, in cases of failure to comply with notices served by an inspector, to be charged to the occupier, and collected in the same way as local taxes.

Two points of interest indicate the view of the Provincial Assembly that prevention is better than cure. In the first place, fines up to one hundred dollars may be inflicted on dealers who sell grain, grass seed, or food products containing a greater proportion of noxious weed seeds than is allowed by the regulations made under Dominion legislation. Secondly, provision is made, under penalties for failure to comply, for threshing machines to be cleaned after the completion of each operation and before the machine is moved, in order to prevent the seeding of clean land with weeds.

One other special provision is, perhaps, worthy of mention. Owners of land are prohibited by the Act from letting any land upon which noxious weeds exist without giving the prospective tenant written notice of the condition of the land, as reported by the local inspector, and obtaining from him a statement that he is prepared to accept all responsibility.

* * * * * *

Timber-Seasoning Invention.

A PROCESS for seasoning timber by subjecting it to the action of a current of air containing a certain percentage of ozone has been invented by M. Otto, Professor at the Sorbonne, Paris. The process is said to give the same result in about twenty days as would be obtained by natural seasoning in the course of several years. A micrographic examination is reported to show that samples of oak and walnut which had been treated by the process show the same characteristics as seasoned wood, while the treatment does not change the colour of the wood. The Otto process is being worked by a French Company which has constructed works at Seregno, near Milan, and will shortly build new works in the neighbourhood of Paris.

* * * * * *

THE International Labour Office quote figures issued by the United States Department of Agriculture which show that as compared with 1916 (the year preceding that in which the United States entered the war) farm wages had increased by 100 per cent. in 1920. These rates were the highest recorded, and during 1921 they fell by about 35 per cent., leaving wages only about 30 per cent. above the 1916 level.

Fall in Agricultural Wages in the United States.

* * * * * *

LICENSING OF STALLIONS UNDER THE HORSE BREEDING ACT, 1918.

SEASON 1922.

THE Horse Breeding Act of 1918 has been in operation since 1st January, 1920. The main object of the Act is to prevent unsound stallions being travelled for service and there is every reason to think that this is now being secured. Applications for licences to travel must be made to the Ministry between 1st November and 31st July, and all licences expire on the 31st October following the date of issue.

The diseases and defects prescribed in the Horse Breeding Regulations of 1919 for England and Wales as rendering stallions unfit for the service of mares are :—roaring, whistling, sidebone, cataract, ringbone (high or low), bone spavin, navicular disease, shivering, stringhalt, and defective genital organs. The returns given in Table II show that the first three named diseases or defects are the most prevalent.

The number of stallions which were licensed by the Ministry during the year ended 31st October last was 3,479, of which 3,129 were pedigree horses, the remainder not being entered, or accepted for entry, in any recognised stud book. In 165 cases applications for licences were refused by the Ministry. An appeal against the refusal of a licence was lodged under paragraph 12 of the Regulations in 28 cases, and 12 of the appeals were successful.

As in the preceding year, the Police co-operated with the Inspectors of the Ministry in securing observance of the Act by stopping stallions on the road and requiring the production of licences by the stallion leaders. Proceedings were taken by the Police in several cases where offences were proved, but there were fewer prosecutions than in previous years. It seems reasonable to assume therefore that evasions of the Act are diminishing.

TABLE I.

	Heavy					Light									Pony and Cob									
	Breeds					*Breeds*									*Breeds*									
Pedigree Stallions, *i.e.*, Stallions entered or accepted for entry in the recognised Stud Book of their Breed	Shire	Clydesdale	Suffolk	Percheron		Hackney	Thoroughbred	Arab	Cleveland Bay	Welsh Roadster	Hunter	Yorkshire Coach	American Trotter		Welsh	Fell	Dales	Polo and Riding	Shetland	Highland	Dartmoor	Welsh Cob		***Totals***
Licensed	2,052	237	216	47	—	213	150	17	9	5	4	2	1	—	28	24	18	18	8	3	1	76	—	3,129
Refused	106	16	8	—	-	5	7	1	—	—	—	—	—	—	1	2	—	—	—	—	—		—	146
Applications	2,158	253	224	47	—	218	157	18	9	5	4	2	1	—	29	26	18	18	8	3	1	76	—	3,275
	Types					*Types*									*Types*									
Non-Pedigree Stallions, *i.e.*, Stallions not entered or accepted for entry in a recognised Stud Book	Shire	Clydesdale	Suffolk	Percheron	Others	Hackney	Thoroughbred	Arab	Cleveland Bay	Welsh Roadster	Hunter	Yorkshire Coach	American Trotter	Others	Welsh	Fell	Dales	Polo	Shetland	Highland	Dartmoor	Welsh Cob	Others	***Totals***
Licensed	122	7	2	2	80	41	4	3	—	1	3		4	18	5	2	13	2	—	—	—	29	12	350
Refused	8	1	1	—	5	2	—		—	—					—		1	—	—		—	1	-	19
Applications	130	8	3	2	85	43	4	3	—	1	3		4	18	5	2	14	2	-	-	—	30	12	369
Total Licensed	2,174	244	218	49	80	254	154	20	9	6	7	2	5	18	33	26	31	20	8	3	1	105	12	3,479
Total Refused	114	17	9	—	5	7	7	1	—	—	—	-			1	2	1	-		—	—	1	—	165
Total Applications ...	2,288	261	227	49	85	261	161	21	9	6	7	2	5	18	34	28	32	20	8	3	1	106	12	3,644

TABLE II.

BREED	Number of Applications	Number of Refusals	Percentage of Refusals	Reasons for Refusal: Whistling	Roaring	Sidebone	Ringbone	Cataract	Stringhalt	Shivering	Defective Genital Organs	Bone Spavin	Inadequately Prolific
Pedigree													
Shire	2,158	106	4.91	33	31	17	10	6	1	7	1	—	—
Clydesdale	253	16	6.32	2	3	7	—	1	3	—	—	—	—
Suffolk	224	8	3.57	2	1	1	1	2	—	—	1	—	—
Hackney	218	5	2.29	1	—	—	—	2	2	—	—	—	—
Thoroughbred	157	7	4.46		—	—	1	—	1	—	3	1	1
Arab	18	1	5.56	—	—	—	—	—	1	—	—	—	—
Welsh Pony	29	1	3.45	—	—	—	—	—	—	—	1	—	—
Fell Pony	26	2	7.69	—	—	—	1	—	1	—	—	—	—
Non-Pedigree													
Heavy	228	15	6.58	1	2	4	3	2	1	1	—	1	—
Light	76	2	2.63	—	—	—	—	1	1	—	—	—	—
Pony and Cob	65	2	3.08	—	—	—	—	1	—	—	—	1	—
Total of Refusals	—	165	—	39	37	29	16	15	11	8	6	3	1

Licences which were in use during the past travelling season expired on 31st October and should then have been returned to the Ministry. Holders of licences who have not yet so returned them should do so immediately, whilst applications for licences or renewals for the 1923 season should be made at as early a date as possible to facilitate arrangements for the examination of the stallions. Forms of application for a licence may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, S.W.1.

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AGRICULTURAL RETURNS, 1922.

PRODUCE OF CROPS IN ENGLAND AND WALES.

Preliminary Statement showing the estimated total produce and yield per acre of the Corn and Hay Crops in England and Wales in 1922, with comparisons for 1921, and the average yield per acre of the ten years 1912-21.

Crops.	Estimated Total Produce. 1922.	Estimated Total Produce. 1921.	Acreage. 1922.	Acreage. 1921.	Estimated Yield per Acre. 1922.	Estimated Yield per Acre. 1921.	Average of the Ten Years 1912–21.
	Quarters	*Quarters.*	*Acres.*	*Acres.*	*Bushels.*	*Bushels.*	*Bushels.*
Wheat ...	7,649,000	8,722,000	1,966,826	1,975,979	31·1	35·3	30·7
Barley ...	5,060,000	5,309,000	1,363,812	1,435,575	29·7	29·6	30·9
Oats... ...	9,281,000	10,033,000	2,157,172	2,147,594	34·4	37·4	38·3
Mixed Corn ...	509,000	570,000	123,823	134,898	32·9	33·8	– –
Beans ...	839,000	778,000	272,068	237,174	24·7	26·2	27·3
Peas... ...	261,000	313,000	122,717	105,699	17·0	23·7	24·7
	Tons.	*Tons.*			*Cwt.*	*Cwt.*	*Cwt.*
Seeds' Hay* ...	1,732,000	2,144,000	1,527,646	1,757,536	22·7	24·4	28·4
Meadow Hay†	4,068,000	3,195,000	4,413,118	4,052,450	18·4	15·8	21·5

* Hay from Clover, Sainfoin, and Grasses under rotation. † Hay from Permanent Grass.

The corn crops of this year are generally less favourable than those of 1921, both as regards yield per acre and condition and quality of the grain. The unsatisfactory yields are due mainly to the spring drought, although the cold, wet summer also had a bad effect. Autumn-sown crops came through the winter fairly well, in spite of a rather severe check occasioned by cold weather in March and April, which also caused spring corn to germinate slowly. Spring crops, where sown late, suffered most from the dry weather, and frequently came up thin plants, while in some districts frit fly and wireworm damaged the oats severely. Crops ripened slowly and unevenly, and, with unfavourable weather at harvest, the ingathering was very protracted, and a fair proportion of the crops was harvested in rather damp condition. Wheat, however, is of very fair quality, and winter oats are generally fairly satisfactory, but spring oats are of inferior quality, the grain being light. Much barley is discoloured, with a poor sample where there were two growths, and the proportion fit for malting is less than usual.

Wheat is the only corn crop to give an over-average yield, the yield per acre being estimated at 31·1 bushels, or nearly half a bushel above the average of the ten years 1912–21, but more than 4 bushels below the record crop of last year. Most eastern counties obtained appreciably heavier yields than usual, Norfolk being an outstanding exception. The total production is estimated at 7,649,000 quarters, or 1,070,000 quarters less than in 1921, but 700,000 quarters greater than the pre-war average. The total production of barley, 5,060,000 quarters, is 250,000 quarters less than last year and, apart from 1915, is the smallest recorded since official returns were first collected in 1885. The yield per acre is estimated at 29·7 bushels, or practically the same as in 1921, and about $1\frac{1}{4}$ bushels per acre below average. Counties in which fen land predominates secured better crops than usual, but under-average yields were the rule in practically all other counties. The yield per acre of oats, 34·4 bushels, is 4 bushels per acre below the ten-year average. This yield per acre is also slightly under the lowest previously recorded. Yields were relatively the worst in Norfolk, Shropshire, Derby, and Stafford, but in hardly any counties were they up to average. The total production of 9,281,000 quarters is the smallest since 1912, and 750,000 quarters less than in 1921. Mixed Corn yielded 32·9 bushels per acre, and the total production of 509,000 quarters is some 60,000 quarters less than last year. As a result of the increased acreage, the total production of beans, 839,000 quarters, is 60,000 quarters greater than in 1921, in spite of a poorer crop. The yield of 24·7 bushels per acre is $1\frac{3}{4}$ bushels less than last year, and $2\frac{1}{2}$ bushels below average. Peas are by far the worst crop on record, the yield per acre being estimated at only 17 bushels, or $7\frac{3}{4}$ bushels below the ten-year average, and $1\frac{3}{4}$ bushels less than the previous lowest in 1885. The total production of 261,000 quarters is 52,000 quarters less than last year, and lower than in any year, except 1916 when practically a similar total crop was obtained from an area about 30 per cent. less.

The growth of hay was retarded by the cold, dry spring, and much of the seeds was a thin plant as a result of the drought of 1921, so that hay crops were also very unsatisfactory. Most of the seeds hay was secured in good condition, but the bulk of the meadow hay was more or less weathered, and the quality of a fair proportion was impaired owing to delay in cutting. Seeds hay gave a total crop of only 1,732,000 tons, which is the smallest production since 1893, and about 400,000 tons less than in 1921. The yield per acre of 22·7 cwt., is $1\frac{3}{4}$ cwt. less than last year, and $5\frac{3}{4}$ cwt. below the ten-year average. It will be understood that these figures apply to the area of seeds actually cut for hay, and take no account of the area of seeds ploughed up. Yields were very light in practically every county, though they were relatively better in the north and in Wales than in other parts of the country. Meadow hay yielded better than last year, being estimated at 18·4 cwt. per acre, against 15·8 cwt. in 1921, but still some 3 cwt. per acre below average. The acreage was greater than in 1921, so that the total production of 4,068,000 tons shows a welcome increase of 870,000 tons. The total quantity of hay produced this year is therefore about 5,800,000 tons, or 460,000 tons more than in 1921, but still some 1,500,000 tons below the average of the ten years, 1912–21.

The estimates of the potato and root crops will be issued later in the year.

PRODUCE OF HOPS.

Preliminary statement showing the estimated total production of Hops in the years 1922 and 1921, with the acreage and estimated average yield per statute acre in each county of England in which Hops were grown ; and the average yield per acre of the ten years 1912—1921.

Counties, &c.		Estimated Total Produce.		Acreage returned on 4th June.		Estimated Average Yield per Acre.		Average of the ten years 1912 to 1921.
		1922.	1921.	1922.	1921.	1922.	1921.	
		Cwt.	Cwt.	Acres	Acres.	Cwt.	Cwt.	Cwt.
Kent	East ...	46,000	39,000	4,095	4,005	11·2	9·6	11·4
	Mid ...	72,000	52,000	5,528	5,414	13·1	9·7	12·0
	Weald ...	88,000	52,000	7,113	6,634	12·4	7·9	10·7
	Total, Kent	206,000	143,000	16,736	16,053	12·3	8·9	11·3
Hants		11,000	9,000	1,073	1,043	10·3	8·4	9·9
Surrey		2,200	1,500	217	196	10·1	7·4	8·2
Sussex		33,500	12,700	2,354	2,269	14·2	5·7	9·9
Hereford		30,000	33,000	3,945	3,522	7·6	9·5	8·1
Worcester ...		17,700	24,000	2,032	1,963	8 7	12·1	8·7
Other Counties*		500	760	95	87	5·2	8·7	6·7
Total ...		301,000	224,000	26,452	25,133	11·4	8·9	10·4

* Salop, Gloucester, Berkshire and Suffolk.

NOTE.—The total production this year is estimated at 301,000 cwt., or 77,000 cwt. more than last year, and 26,000 cwt. above the average of the ten years 1912-21. Except in East Kent the yields per acre were above average in the south-eastern counties, especially in Sussex where a heavy crop of 14·2 cwt. per acre was obtained. In the western counties yields were not so satisfactory, being half a hundredweight below average in Herefordshire and just average in Worcestershire. Results this year were therefore the reverse of those of last year, when the western counties had good crops and the south-eastern counties lighter crops than usual.

* * * * * *

Foot-and-Mouth Disease.—Since the outbreak at Harmondsworth, Middlesex, on 20th October, which was referred to in the last issue of *The Journal*, eight further outbreaks have occurred of which four were in the district to which restrictions were applied consequent upon the discovery of disease at Harmondsworth, the remaining four outbreaks being confirmed in the Woodstock district of Oxfordshire.

In the Home Counties area, outbreaks were confirmed at Walton-on-Thames (Surrey) on 28th October, Windlesham (Surrey) on 30th October, Staines (Middlesex) on 30th October, and Worplesdon (Surrey) on 13th November, but no connection could be traced between any of these and the original outbreak at Harmondsworth, nor were the later outbreaks apparently connected with each other. The outbreaks at Windlesham and Worplesdon rendered it necessary to extend the district subject to restrictions. The entire prohibition of movement of animals is now limited to five small areas around the other infected places. In the remainder of the scheduled area which has been

considerably reduced, movement is permissible by licence, and fat stock markets can be held by licence subject to inspection.

The initial outbreak in Oxfordshire occurred on 25th October, when two cases were confirmed at Woodstock. The usual Order was imposed in respect of an area with a radius of 15 miles of the infected places. Subsequently, two outbreaks occurred on 30th October and 4th November respectively, on premises in the vicinity of the earlier cases. The origin of the infection in this district cannot be ascertained, but all the 4 outbreaks were connected.

In this district also the restrictions have been considerably modified and entire prohibition of movement applies only in respect of two small areas surrounding the infected premises.

In all cases, the slaughter of all the affected animals and those in immediate contact has been carried out, involving 107 cattle, 2 sheep, 207 pigs and 1 goat.

Agricultural Research Scholarships and Fellowships.—The Ministry of Agriculture and Fisheries, on the recommendation of the Advisory Committee on Agricultural Science, and with the concurrence of the Development Commissioners and the Treasury, have awarded *Research Scholarships*, of the value of £200 per annum for three years, to the following candidates :—

Mr. N. C. Wright, University College, Reading (Dairying).

Mr. W. L. Davies, University College, Aberystwyth (Animal Nutrition).

Mr. Ronald C. Fisher, Edinburgh University (Entomology).

Mr. P. Halton, University College, Reading (Animal Nutrition).

Mr. Edgar Thomas, University College, Aberystwyth (Agricultural Economics).

The Ministry has also extended for a third year the 2-year scholarships previously awarded to :—

Mr. J. H. Frew (Rothamsted Experimental Station) in Entomology ; and to

Miss M. S. Lacey (Imperial College of Science) in Plant Bacteriology.

These scholarships have been established in order to assist promising science graduates to qualify as research workers with a view to their contributing to the development of agricultural science.

Travelling Research Fellowships have been awarded to :—

Mr. G. W. Robinson, of University College, Bangor, for a visit to America to study soil survey methods ; and to

Col. W. A. Wood, of the School of Agriculture, Cambridge, for a visit to Kiel to study methods of treating sterility.

The fellowships have been instituted to enable selected members of the staffs of institutions aided by the Ministry to visit foreign countries where research work on similar subjects is carried on and to study at first hand the methods followed there.

International Poultry Exhibition.—An International Poultry Exhibition will be held at Liege on 20th—22nd Jan. next, and entries of five or six pens of three birds each are invited from British breeders. Belgian poultry breeders are particularly interested in such breeds as Orpingtons, Minorcas, Sussex, and Dorkings. Inquiries should be addressed to the Secretary, International Exhibition of Aviculture, Société Royale Union Avicole de Liege, Belgium.

Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE,
By Metchim & Son, Princes Street, Westminster, S.W. 1.

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXIX. No. 10.

JANUARY, 1923.

NOTES FOR THE MONTH.

THE Prime Minister made the following statement in the House of Commons on 11th December:—

Agricultural Economic Inquiry.

"The Government propose to set up a Tribunal of Investigation, consisting of three well-known economists, with the following reference:—

'To inquire into the methods which have been adopted in other countries during the last 50 years to increase the prosperity of agriculture and to secure the fullest possible use of the land for the production of food and the employment of labour at a living wage, and to advise as to the methods by which those results could be achieved in this country.'"

At the time of going to press, the names of the economists to be appointed had not been announced.

* * * * * *

Departmental Committee on the Distribution and Prices of Agricultural Produce.

THE Minister of Agriculture has now set up the Committee which is to inquire into the methods and costs of selling and distributing agricultural, horticultural, and dairy produce in Great Britain, and to consider whether, and if so by what means, the disparity between the price received by the producer and that paid by the consumer can be diminished. The constitution of the Committee is as follows:—The Marquess of Linlithgow (Chairman), Sir Basil Mayhew, K.B.E., Mr. A. W. Ashby, Mr. Ernest R. Debenham, Dr. Charles M. Douglas, C.B., Mr. Percy A. Hurd, M.P., Mr. Rowland R. Robbins, C.B.E., Mr. R. J. Thompson, O.B.E., Mrs. Margaret

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Wintringham, M.P. The Secretary of the Committee is Mr. A. W. Street, and the Assistant Secretary, Mr. F. Grant, both of the Ministry of Agriculture and Fisheries.

The first meeting of the Committee was held on 15th December, to consider the procedure. The Committee decided to hold meetings in private, and to take evidence from representative associations immediately after Christmas.

* * * * * *

Committee on Agricultural Credit.

A SMALL expert Sub-Committee was appointed by an agricultural Committee of the late Cabinet in October last to consider the question of agricultural credit. The Sub-Committee has held fifteen meetings, which, so far, have been devoted almost exclusively to the hearing of witnesses. It is understood, however, that it has now concluded the taking of evidence and is proceeding to the consideration of its report, which should be in the hands of the Minister early in the New Year.

* * * * * *

Importation of Animals Act.

A BILL to give effect to the agreement come to between the Cabinet and the Canadian Government with regard to the future conditions of importation of cattle from Canada and other parts of the British Empire, was passed by both Houses of Parliament during the past month and received the Royal Assent on 15th December, 1922. The agreement with the Canadian Government* is confirmed in the Act, which provides that Canadian store cattle brought direct from a Canadian port may be imported into Great Britain on condition that for 3 days before shipment and during the voyage the animals are kept separate from other animals and examined from time to time by an authorised veterinary officer of the Dominion, and found to be free from cattle plague, pleuro-pneumonia or foot-and-mouth disease. The cattle must be marked before shipment and must also at the time of shipment be free from mange or any other disease specified by the Ministry. The cattle are required to be landed at approved landing places where each cargo has to be detained and isolated for such period as is required for examination by veterinary inspectors of the Ministry. No cattle may be removed from the landing place except with a licence of the Ministry's Inspector, and then only to premises on which they are required to be detained for 6 days

* See this *Journal*, Dec., 1922, p. 770.

except that the cattle may pass to such premises through one market.

The Act also empowers the Ministry by Order to authorise the importation of Canadian animals other than store cattle without being subject to slaughter at the ports, but subject to certain conditions for the purpose of preventing the introduction of disease. The Act further makes statutory the existing requirement of 6 days' detention in the case of cattle landed from Ireland.

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A Survey of Fruit Soils.

A QUESTION on which the farming community is frequently asking advice is whether certain land is suitable for fruit-growing. To obtain fuller information than is at present available on this matter, an investigation is being begun by the horticultural stations at Cambridge University and at Long Ashton, Bristol University. Its precise object is to ascertain the extent to which fruit-growing can be correlated with soil type in two very distinct districts, viz., East Anglia and West Midlands. In the first district—East Anglia—fruit is grown on a variety of soils, while in the second district—the West Midlands—it is grown apparently on a single definite soil type. Factors, other than soil type, however, such as climate, altitude, aspect, and water table, which may influence suitability for fruit culture, seem to be relatively uniform in the first area, and to differ widely in the second.

Before the main work of the investigation could be commenced, it was necessary to determine the depth to which the soil sampling should be carried out. A preliminary investigation was made by the Long Ashton Station as to the extent and depth of the root range of fruit trees, and it seems that, for the types of soil in question the important zone of root range lies within two feet of the surface. This preliminary root investigation will be repeated by the Cambridge Horticultural Research Station.

The main survey will include at each plantation visited an examination of soil character, and behaviour of fruit trees; as far as possible, the features presented by all varieties of fruit will be recorded. An assistant soil analyst will be employed at each station for the analytical work. Plant pathologists already at the two Universities will co-operate in the investigation for the purpose of collecting information on diseases and pests of fruit trees under various conditions.

A special committee consisting of representatives of the two stations will co-ordinate the work. The small amount of money required is being provided by a grant from the Development Fund.

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Standardisation of Chip Baskets.

IN a recent issue of this *Journal* (October, 1922) an article by Mr. J. Stoddart gave an account of the investigations that had been conducted by the Ministry into the question of the standardisation of packages for soft fruit. At a public meeting convened by the Ministry in July last these investigations were brought to the notice of those interested, and it was agreed that basket manufacturers should submit to the Ministry of Agriculture samples of their chip baskets, and that if the capacities be approved by the Ministry, the makers shall be entitled to stamp all similar baskets "No. 3 (or 4) Approved Standard Capacity."

So far eight firms have submitted samples of chip baskets, the capacities of which have been approved:—

The British Basket Co., Ltd., Leverington Road, Wisbech; Messrs. Dewsbery Bros., Wisbech; Messrs. J. Deaton & Son, Old Ford, London, E.; The Hulme Patent Advertising Match Co., Irlam, near Manchester; The Manchester Basket Co., Manchester; Geo. Marchant, The Lodge, Botley Road, Woolston, Southampton; The Tamar Valley and District Chip Basket and Box Making Factory, Ltd., Calstock.

These firms have been informed that similar baskets to these specimens may be stamped "Capacity approved by the Ministry of Agriculture and Fisheries." It is known that some of the above firms are already sending out baskets bearing these or similar words.

The advantages which would accrue to the horticultural industry as a whole by the use of packages of standard capacities have been dealt with so fully that it seems hardly necessary to discuss them. It may perhaps be worth while, however, to repeat that to the grower the use of standard packages would bring considerable gain. With packages of varying sizes his only means of ascertaining that the correct quantity of produce has been packed, is to weigh up each package separately—undoubtedly the proper method, though not yet generally followed. Unweighed packages will generally contain more than the reputed weight or less. Numerous complaints will be made in respect of the "shorts" and deductions made from the sales returns, whilst the over-weight will bring no advantage.

The grower who uses packages of varying capacities without weighing is, therefore, likely to lose financially and to bring discredit on himself for faulty business methods. In fact, present methods are being severely criticised by the retailers who experience serious losses from short weights, and they are pressing for the introduction of legislation to secure that the sale of all fruit and vegetables shall be by net weight or count. However successful such legislation may be in other countries, coercive methods in Great Britain are usually undesirable and are resorted to only when voluntary methods have failed. It is difficult, however, to see what defence can be put up to the demand for such legislation unless there is improvement in existing methods, and it may be wiser, therefore, to give the Voluntary Standardisation System of packages a chance. With the active support of the whole industry it would appear possible to obtain in the near future the general adoption of standard packages. Wherever possible, growers would be wise in their own interests to pack their produce in packages bearing marks showing they are of approved standard capacity. The British Standard Apple Box has already established itself in favour, and Standard Chip Baskets from several makers are now available for soft fruit. Some progress is being made, therefore, and it can be tested whether or no retailers will give them a preference. If the industry shows its desire to make this system successful the principle can be extended to other market packages.

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Potato Demonstration Plots, 1923.

THE importance of the potato crop renders it desirable that every grower should have an opportunity of comparing the crops of the newer varieties, which are immune from Wart Disease, with those of established kinds grown in his district, and of seeing in practice the most up-to-date systems of cultivating and manuring the crop. The Ministry proposes therefore to continue in 1923 potato trials on similar lines to those carried out during the past four years.

The trials will, as before, be carried out by the Local Authorities for agricultural education. The main objects will be the demonstration of:—(*a*) the cropping powers of the newer varieties; (*b*) the advantages of an adequate system of manuring; and (*c*) the value of using "seed" from healthy stocks.

The Ministry has decided to include three of the most popular varieties susceptible to Wart Disease, in order to pro-

vide growers with a comparison of the cropping qualities of the immune and the susceptible varieties. These will not be planted on land which is known to be infected with Wart Disease.

Varieties.—The varieties chosen for the Trials are:—

Immunes.—1st Earlies - Immune Ashleaf and Dargill Early.
2nd Earlies - Ally, Great Scot and Arran Comrade.
Maincrop - Tinwald Perfection, Kerr's Pink, Majestic, Bishop, Irish Chieftain, Rhoderick Dhu and Crusader.
Susceptibles.—Up-to-Date, Arran Chief and King Edward.

Supply of Seed.—The seed for the 1923 trials has been grown on a farm in Easter Ross. The crops were examined whilst growing and all plants affected with Black Leg, Mosaic, or Leaf Curl, and those not true to the variety were rogued out by the Ministry's inspectors.

It has been suggested to the Local Authorities that in cases where seed has been saved from the trials carried out in 1922, some should be planted in 1923 so that a comparison can be made between the cropping qualities of this seed "once grown" in England and seed direct from Scotland. If similar tests were made in 1922, the trials may be further extended to include seed "twice grown" in England.

Reports on the previous trials have appeared in this *Journal*, July, 1921, p. 350; May, 1922, p. 163.

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Conciliation Committees in Agriculture.

THE Anglesey Committee has reached an agreement to operate for six months up to 13th May next. It provides for the payment of a rate of 28s. for a week of 58 hours (including Sundays) to male workers of 21 years of age and over, and proportionate rates for male workers between 18 and 21 years. It has been agreed that the provision of board and lodging shall be reckoned at 14s. per week and board only at 10s. per week. The Saturday half-holiday is to be observed.

Average Wages.—In reply to a question by Mr. Hope Simpson on 5th December, the Minister stated that from such information as was at the disposal of his Department it was estimated that the average minimum cash wage of ordinary agricultural labourers in England and Wales in November, 1922, was 28s., as compared with a wage of 18s. (including allow-

ances) in 1914, an increase of 55 per cent. The cost of living figures estimated by the Ministry of Labour showed an increase on 1st November of 80 per cent. above the 1914 level.

Unemployment Insurance.—The Minister informed Captain Bowyer on 5th December, in reply to a question as to whether the extending of benefits of the Unemployment Insurance Act to agricultural workers had been considered, that the question of the application of the Act to agriculture was considered as recently as last year by a Committee appointed by the Agricultural Wages Board, and representatives of the farmers' and farm workers' organisations. That Committee reported that there was general opposition both by employers and workers to the inclusion of agriculture in the general provisions of the Act. The Minister added that, so far as he was aware, the general feeling in the industry remains as then reported.

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The Agricultural Index Number.

A FURTHER rise was recorded for November in the average prices of agricultural produce in England and Wales, the increase compared with the corresponding month in the years 1911-13 being 62 per cent. in November against 59 in October. There has thus been a rise of 5 points in two months, but the November figure remains decidedly lower than any recorded during the first eight months of the year. The proportionate increases in price since the beginning of 1920 are shown in the following table:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.
January	200	183	75
February	195	167	79
March	189	150	77
April	202	149	70
May	180	119	71
June	175	112	68
July	186	112	72
August	193	131	67
September	202	116	57
October	194	86	59
November	193	79	62
December	184	76	—

The increase in prices in November was fairly well distributed among the various descriptions of produce, fat cattle and

sheep, poultry and eggs being the only products sold off farms, which were relatively cheaper in November than in October, and in these cases the reductions were small. Cereals continued the rise recorded by the figures for the previous month, wheat being 32 per cent., barley 34 per cent. and oats 38 per cent. dearer than the average for November, 1911-13; in November of last year the corresponding figures were 41 per cent. for wheat, 61 per cent. for barley and 35 per cent. for oats. Potatoes, fruit and vegetables have all advanced, while hay remains unaltered, the slight fall in the price of hay in November corresponding with the fall which occurred from October to November in 1911-13.

Fat cattle were slightly cheaper in November than in the previous month, and the index number for fat sheep is also lower, in spite of a small increase in prices, the fall in the index number being due to the fact that there is normally a greater proportionate seasonal rise between October and November. Pigs are decidedly dearer. Store cattle and sheep fell slightly, but dairy cows show a further rise. Store pigs also advanced, by a further 13 points, and during November were nearly 2½ times as dear as in November before the war. The advance is the more remarkable as a fall is customary at this time of the year, and it is evident that the high prices at present realised for fat swine, and the large quantities of surplus potatoes in the country, are creating an unusual demand for store pigs.

Milk and butter have remained practically unchanged, but cheese has advanced sharply in value, and in spite of a normal rise in price at this season of the year, the index number has jumped 19 points. Eggs although considerably dearer in November, show a slight fall compared with the corresponding month in 1911-13, as the normal seasonal rise in value is greater than that registered this year.

The average increase in agricultural wages during November, as compared with a pre-war wage of 18s. per week, was 55 per cent. as against an increase of 60 per cent. in October. These figures are calculated on the basis explained in the article in the December issue of the *Journal*.

The following table shows the average increase during recent months in the value of the principal commodities sold by farmers, together with corresponding figures for November, 1921 :—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

Commodity.	1922. July.	1922. Aug.	1922. Sept.	1922. Oct.	1922. Nov.	1921. Nov.
Wheat ...	53	53	23	24	32	41
Barley ...	49	48	26	29	34	61
Oats	55	59	31	33	38	35
Fat cattle ...	70	70	58	49	48	75
Fat sheep ...	107	103	90	90	87	53
Fat pigs ...	91	92	84	85	94	70
Dairy cows ...	64	67	63	69	74	102
Store cattle ...	39	42	33	30	29	46
Store sheep ...	108	114	109	106	93	50
Store pigs ...	115	128	125	135	148	82
Eggs... ...	80	64	96	104	98	144
Poultry ...	103	85	85	77	75	80
Milk	53	70	70	90	90	117
Butter ...	79	77	76	71	72	69
Cheese ...	50	51	41	36	55	25
Potatoes ...	75	14	1	3	8	135
Hay	37	54	52	45	45	45

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Export of Pedigree Stock.

THE Ministry has recently been informed by the Department of Overseas Trade that the exportation of live stock for breeding purposes may properly be included within the scope of the Export Credit Scheme. Agriculturists desirous of obtaining credits in this connection should, therefore, make application to the Export Credits Department of the Department of Overseas Trade, 73, Basinghall Street, London, E.C. Full information as to the methods and scope of the Scheme, together with forms on which application should be made, will be supplied by that Department on application.

It will be understood that the Export Credits Scheme has been provided by the Government in order to facilitate the resumption of the ordinary means whereby traders and others can obtain facilities from their bankers to enable them to finance their export trade. Under it the Government are prepared, under certain conditions, to entertain proposals to guarantee drafts drawn against shipments of goods exported from the United Kingdom. All applications are required to be submitted through the exporter's bankers. Guarantees may be given under two systems: (*a*) for general credits, that is to say, credits which do not involve a separate reference to the

Department in respect of each specific transaction, and (b) credits in respect of specific transactions.

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Answers to Correspondents.

THE Ministry receives a considerable number of inquiries dealing with the more technical side of agriculture. In many cases these are, in accordance with the arrangements described in Leaflet No. 279 (*Technical Advice for Farmers*), passed on to the County Agricultural Organisers. These officers are naturally in a better position to advise on matters requiring a knowledge of local conditions than the Ministry's advisers at Headquarters. Some inquiries are, however, dealt with by the Ministry direct and it is proposed to publish from time to time a selection of replies given in the hope that these may be of interest to a wider circle than the correspondent to whom they were originally addressed. A first instalment of these replies will be found on page 956 of the present issue.

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Corn Sales Ready Reckoner.

WITH the object of assisting farmers and other buyers and sellers of corn and seeds to accustom themselves to selling by reference to the cwt., in accordance with the Corn Sales Act, 1921,* which comes into force on 1st January, 1923, the Ministry has prepared a series of tables of equivalent prices. These tables give for a price per cwt. of 5s. and each additional 2d. up to 18s., the equivalent price for the chief customary weights by which the different kinds of corn and other produce have been sold in the past. This set of tables has been published as "The Corn Sales Ready Reckoner" and is obtainable through any bookseller, price 5d., or from H.M. Stationery Office, Imperial House, Kingsway, W.C.2, price 6d. post free.

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* See this *Journal*, December, 1922, p. 778.

PATRINGTON FARM SETTLEMENT.

CAPTAIN J. K. HILL,
Director of the Settlement.

The Estate and its Administration.—The Patrington Estate was the first to be acquired by the Ministry of Agriculture and Fisheries under the Small Holding Colonies Acts, 1916 and 1918, with the object of establishing farm settlements for ex-Service men. The property, which is held on a 99 years' lease from the Office of Woods, is situated on the Humber Estuary about 15 miles east of Hull, in the area known as Sunk Island. On an 18th century map this island is shown to be only some 8 acres in extent, but it now comprises some 10,000 acres, representing the results of natural alluvial deposit and of land reclamation work during the past two centuries. The land taken over by the Ministry in 1917 extends to 2,363 acres, and a further 503 acres were acquired in 1919, but this latter portion has since been let off as one farm, and is not now included in the settlement area.

The Patrington Settlement is carried on under a scheme devised by the Ministry to meet the needs of ex-Service men, skilled or partially skilled in agricultural work, but without capital or possessed of insufficient means to enable them to take up the cultivation of a small holding. Briefly described, this scheme provides for the management of the settlement by the Ministry, but the profits, after all working expenses have been paid and an allocation made to a reserve fund, are divided between capital, management and labour in proportion to the amounts charged in respect of these items in the working account. A substantial profit was made in the first two years after the settlement was started, but since then, owing to the bad seasons and the agricultural depression, farming operations have resulted in a loss. The employees are paid wages at the rates prevailing in the district, and with very few exceptions ex-Service men furnish the whole of the labour employed. Another factor bearing on the adoption of the scheme was the unsuitability of the soil for farming in small areas, thus precluding the formation of small holdings grouped round a central farm as recommended by the Verney Committee.

For farm work in the neighbourhood it is customary to rely mainly on boys, who board and lodge with the foreman, and who are supplemented by casual workers when any additional

labour is required. This arrangement has a considerable advantage in keeping down the wages bill, but is impossible of adoption when the main purpose is to resettle married ex-Service men on the land. From a purely economic standpoint, therefore, the expenditure on labour on the settlement must necessarily be higher than on farms where the older local practice obtains. On the other hand, the number of persons formerly living on the area now farmed by the Ministry was probably never more than 65, whereas, on the settlement to-day, there are 55 married couples with 130 children, a total population of 240. The value of this contribution towards the larger social problems of rural resettlement and relieving the congestion of the towns must, obviously, be taken into account.

To house this large increase of population the Ministry added 40 new cottages to the existing accommodation. These are built in pairs and are of brick with tile roofs, each containing parlour, living-room, scullery and three bedrooms. A double pig sty with run and half an acre of garden ground have also been provided with each cottage. Thirty-six of the cottages were erected by August, 1919, and the building work since carried out up to the completion of the equipment in January, 1922, consisted chiefly of the repair and adaptation of existing buildings, the erection of the piggeries, and the provision of baths.

The addition of baths to the new cottages throws an interesting side-light on the stamp of man who has been settled at Patrington, for baths were not originally contemplated in the early building scheme, and their subsequent provision was a concession by the Ministry to a unanimous and insistent demand by the settlers.

Social Amenities.—The settlement has shaken down into a self-respecting community; and the present employees are of a good class of men and proud to constitute a virile branch of the British Legion from which they derive an excellent tone and social spirit

This *esprit de corps* is particularly desirable as the settlement has to be self-dependent for its recreation. Entertainments of various kinds are given during the winter months in a special Recreation Hut which has been erected. This is also used for religious services, and for a Sunday School, conducted by residents, which has a good attendance of children. Special outdoor festivities are the Annual Sports both for children and adults, and patriotic celebrations on anniversaries such as Empire Day and Armistice Day.

Farming Operations.—This brief outline of the conditions under which the settlers live and work brings us to the actual cultivation of the land. The area comprises five farms, of which 1,777 acres are arable and 531 permanent pasture. The soil consists of a mud warp, varying in depth from six inches on the inner lands to four inches or less near the Humber bank, where nothing will grow which comes in contact with the silt subsoil. The methods of cultivation and cropping generally obtaining in the district are largely followed on the settlement, but certain departures from local practice have been instituted for the purpose of studying their efficacy under local conditions.

Sub-soiling constitutes one of these departures, and is worthy of a full trial. To avoid bringing up the unfertile silt, ploughing is kept to a very limited depth, with the result that a hard pan has been formed which is never broken up. The deeper cultivation and rough form of sub-soiling which the steam tackle affords have given very satisfactory cropping results; and sufficient work has been carried out on these lines to show that the land would readily respond to the principle of sub-soiling when carried out with modern implements that effectively break up the pan without risk of bringing up the silt

Bare Fallow, and Fodder Crops.—With the farming conditions applicable to the soil and the district, where successive corn crops are grown, it is necessary, in the ordinary course, to introduce a bare fallow so that, whether foul or not, the soil may recover its fertility. This course is necessarily expensive, and its restriction on the possible output of the farm can be ill afforded in the present hard times. On the other hand, a leguminous crop, such as tares, may be relied upon to restore fertility to the land and reclaim the lost physical condition of the soil. It has been demonstrated during the past two years that Sunk Island land is ideally constituted for forage cropping and the production of silage, while for many reasons it is unsuitable for roots, which, consequently, are grown only in small quantities. It is hoped, therefore, that a sufficient substitute for the latter will be furnished by leguminous forage crops converted into silage. These should have the dual advantage of providing a valuable food substitute for roots, much needed in this class of farming, and also obviating the necessity for so many bare fallows.

Stock Keeping.—With a large bulk of straw to be consumed or trodden into manure, a heavy head of stock has to be main-

tained through the winter. In the absence of roots, the customary method in the district is to feed straw only as a bulk food, supplemented by cake and meals to the cattle in the yards, necessitating a heavy ration of concentrates to maintain them in good store condition. If beef had remained at war values or cake were half its present price, the system might be economically sound, but in the present circumstances it is difficult to see how it can be carried on profitably as a means of supplying manure for the land. The production of silage in sufficient quantity would, however, go far to meet the need for economical feeding, as store cattle fed with it would require far less of the concentrated foods.

Artificial Manure from Straw.—The method recently discovered of converting straw into valuable manure through the action of nitrogenous bacteria, may be of the greatest value in a corn-growing district where farmyard manure is a necessity and where a superabundance of straw has to be utilised. Such a drastic innovation, however, would be too serious an adventure for the ordinary farmer to embark upon without a convincing demonstration of its efficacy, but the possibilities are attractive and the system might prove of the greatest benefit in corn-growing districts generally. More particularly would it help those farmers who, for temporary financial reasons, are unable to ensure the productivity of their land by keeping a sufficient head of stock.

High Wheat Yields.—Holderness, and more especially the Sunk Island area, is an important wheat growing district, and very heavy yields are recorded. In 1921, 585 acres of wheat were harvested on the settlement, the highest yield per acre being just under 9 quarters of White Victor, and a satisfactory average of 6 quarters was obtained from the autumn-sown wheat. In the 1922 season, which was six weeks later than the previous year, there were 638 acres of wheat for harvest, but as yet no thrashing has taken place. It is feared that the want of sufficient sun has been responsible for a disappointing yield; there is a heavy bulk of straw and the crops were very badly laid by wind and rain. So far there has been no experimental work to determine the comparative yields of different varieties of wheat, which it is essential should be carried out under identical conditions in the same field. As some of the fields exceed 50 acres in extent it should be possible to obtain a convincing demonstration in the future on such an acreage

That Victor wheat gave the highest individual yield last year cannot be regarded as conclusive, as any other variety might have done equally well on the same field. From observation of the standing crops for the past two years Yeoman stands first, with Victor a good second. The former is more in favour with millers and the straw appears to stand better than that of Victor under stress of wind and weather. Good returns have also been obtained from the Old Norfolk Grey Chaff. On the other hand Swedish Iron was given up in the past season, as on this land it produced a coarse thick-skinned sample not at all liked by millers, while Little Joss and Benefactor have been discarded owing to an apparent lack of strength in the straw. Until this season Red Byrell had also been grown, but it has not found favour on the settlement.

Mustard Growing.—Mustard grown under contract is a popular crop in the district and has been extensively grown on the settlement; but with a drop in price from £12 per quarter two years ago to £4 16s., which is the offer for next season's crop, it is questionable if it is a paying proposition compared with wheat, even at 40s., in view of the latter's less costly harvesting and threshing.

Grass Land.—The grass land is not of the first quality, as feeding bullocks need help to bring off fat; neither is it suitable as a whole for young stock. The rougher pastures, however, appear to respond well to treatment, such as heavy winter dragging and the application of slag and other phosphates.

Pig Keeping.—Pigs are a strong feature on the settlement, some sixty breeding sows being kept. The Large Black is the principal breed, and intercrossing is also carried out with Middle White boars for the production of porkers, and Large Black boars on Large White sows for bacon. It is intended now to keep pedigree stock of both the Middle White and Large Blacks.

Farm Equipment.—The farm buildings have been thoroughly repaired since the Ministry took them over and useful alterations and additions have been effected, Dutch barns having been erected on three of the farms. The private roads, which run to a considerable length, have been repaired, and the more important ones, linking up different portions of the Estate, which were almost impassable clay tracks, have been macadamised at considerable outlay. Water has been laid on from the Hull Corporation mains to all the cottages, buildings and yards, also to some of the grazing fields; and the settlement as a whole is

now well laid out and equipped. With these facilities for working, it is hoped that the settlement may institute minor innovations that will further agricultural interests in the district; and there is little doubt that any practical advantages shown to result will be readily taken up and acted upon.

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POTATO LIFTING MACHINERY.

IT is proposed in this article to present what, from the farmer's point of view, are the most important results contained in the recent Report* on potato lifting machinery. The Report is mainly concerned with the third of a series of trials of potato lifting machinery conducted at the Manor Farm, Garforth, by the Authorities of Leeds University, acting in conjunction with the Ministry, but it contains also a summary of results previously obtained. The first investigation was carried out by the University in 1916 and showed that when horse labour cost 2s. 6d. a day, men 4s., women 3s. 6d. and boys 2s. 6d. a day, the cost of harvesting potatoes by hand was 13s. 8d. per ton as compared with 4s. 8d. when a potato-lifting plough was used. The acreage costs were £6 16s. 8d. and £2 6s. 6d. respectively, a difference of £4 10s. 2d. an acre in favour of the plough. In 1919 an investigation was made into the comparative efficiency of a digger plough, a rotary machine and a machine of the elevator type. The cost of harvesting on that occasion came out at 7s. 11d., 6s. 11d. and 8s. 10d. per ton and £3 0s. 3d., £2 11s. 6d. and £3 0s. 6d. an acre respectively.

The investigation in 1921 was on a much larger scale and included 10 machines in all, 7 of the rotary type, 2 of the elevator type, and a combined lifting, sorting and bagging machine. It was not thought necessary to include a digger plough on this occasion. Both the economic and the mechanical aspects of the problem were investigated: *i.e.*, the actual cost of lifting potatoes by various devices was determined, and engineering and mechanical data were collected with a view to studying the principles embodied in each machine.

* "The Use of Implements in the Lifting of the Potato Crop." 1921: University of Leeds and the Yorkshire Council for Agricultural Education, price 2s. 6d.

The Report divides potato-lifting machinery into the following four groups :—

(1) **The Plough Group** which embodies an elementary principle based largely on the ordinary plough. A plough standard carries a broad square-pointed share which runs under the tubers and lifts them up to the first set of raisers consisting of steel prongs set so as to offer resistance to the earth and potatoes. The earth is broken up and the smaller particles allowed to fall through while the larger clods and potatoes are raised to the surface. A second set of raisers catch the potatoes as they fall from the first and further separate them from the soil.

(2) **The Rotary Type** has a scoop share which runs underneath the potato ridge. The soil with the potatoes is removed by a series of rotary arms at the rear, driven at right angles to the track of the machine, which throw the soil and potatoes clear, leaving the potatoes on the surface. There are two principal types of rotary diggers :—

(*a*) In which the tines radiate directly from the driving spindle;

(*b*) In which the tines radiate from the spinner by being attached to a system of links and bars, and thus describe an elliptical path which at the bottom conforms practically to the shape of the share.

(3) **The Elevator Type** embodies the principle of a share or scoop which raises the potato ridge on to a long moving elevator which shakes out the soil. The haulm is thrown off by agitating forks at the top of the elevator and the potatoes are thrown clear of the machine to the rear.

(4) **The Combined Type** of machine was brought from Norway specially for the test. It combines the elevator and rotary principles, and is able to separate the soil and haulm by a series of grids and screens and to collect the potatoes in bags at the rear. The potatoes are sorted out into their different sizes, stones are also separated from the potatoes by a series of moving gravity traps which permit the heavier objects to fall to the ground, whilst the potatoes pass along the elevator into the sack.

The field set apart for the trial was permanent pasture until 1918 when it was ploughed out. The cropping was oats in 1918, wheat in 1919, barley and oats in 1920, followed by potatoes in 1921. The turf had become thoroughly disintegrated and did not interfere with the work of the machines. Part of the area was level but at one end of the plots there was a rather steep gradient which enabled the efficiency of the machines to be studied not only on the flat but also on the up and down

gradients. The soil was typical light coal-measures land and was in good condition for potato growing. The variety of potatoes grown was Great Scot and the crop was in excellent condition for lifting; there was a little second growth but not sufficient to interfere with lifting operations.

For the mechanical part of the investigation dynamometer readings were taken of both digging and road tests, the main factors observed being:—(1) Weight of machine in relation to drawbar load and mechanical efficiency; (2) Ease of handling; and (3) Mechanical construction, having regard to simplicity and access to wearing parts.

For the purpose of obtaining comparative costs, plots containing 12 rows of potatoes ($\frac{2}{11}$ acre in extent) were marked out and each machine was required to work both ways in order to ascertain the effect of the gradient on the work done. The number of pickers was varied, where necessary, so as to keep pace with each machine. After the plots were dug and picked they were harrowed four times and records taken of the quantities of potatoes brought to the surface. A square rod was then forked over by hand in order to ascertain the weight of tubers finally left in the ground. The main factors observed for judging the machines from an economic point of view were:—

(1) Cost of fuel, lubricants and general upkeep;
(2) Labour, amount and cost;
(3) Percentage of damaged tubers;
(4) Work required after digging operations, such as harrowing;
(5) Proportion of total crop finally left in the ground;
(6) Working costs per plot and per acre;
(7) Quantity of work done; and
(8) General adaptability for any other work.

The following is a summary of the results contained in the Report:—

(1) **Bamlett Improved Potato Digger (Link Type)**, manufactured by Messrs. A. C. Bamlett, Ltd., Thirsk.

Summary of Results.

		T.	cwt.	qr.	lb.
Total weight lifted	per plot	2	4	0	0
Total weight of harrowings	,,	0	3	0	3
Total weight damaged	,,	0	0	0	24
Estimated weight left in ground ...	,,	0	2	2	10
Total cost per acre			£2 11 7		
Cost per ton of saleable ware and seed lifted ...			£0 8 9		
Total net returns per acre from all tubers lifted ...			£39 10 9		
Speed of travel in miles per hour				3·4	
Average distance potatoes thrown		4 ft. 3 in.			
Maximum distance potatoes thrown		12 ft. 0 in.			
Drawbar load in work			372 lb.		

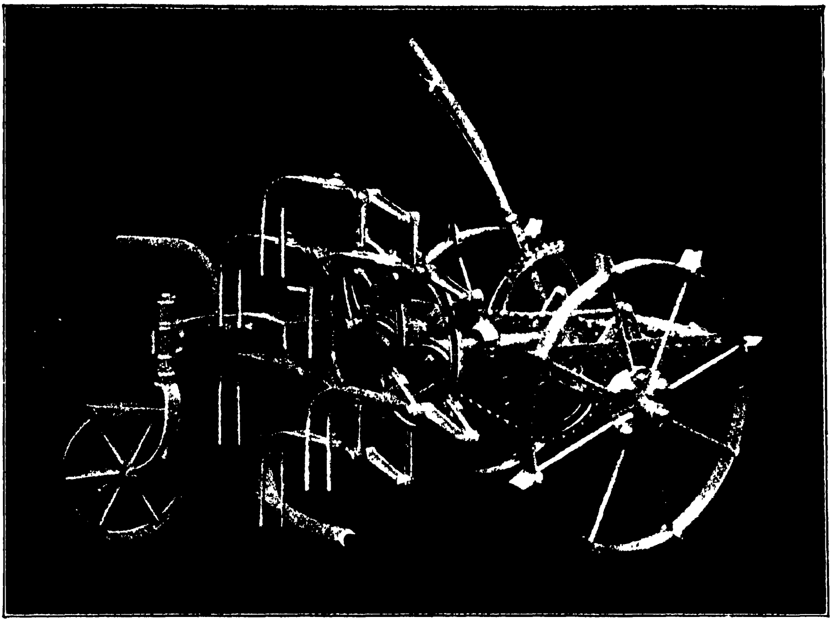

Fig. 1. Improved Potato Digger (Link Type).

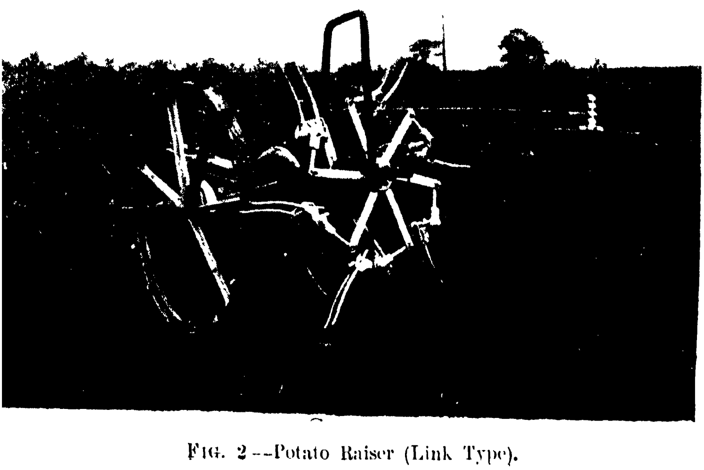

Fig. 2—Potato Raiser (Link Type).

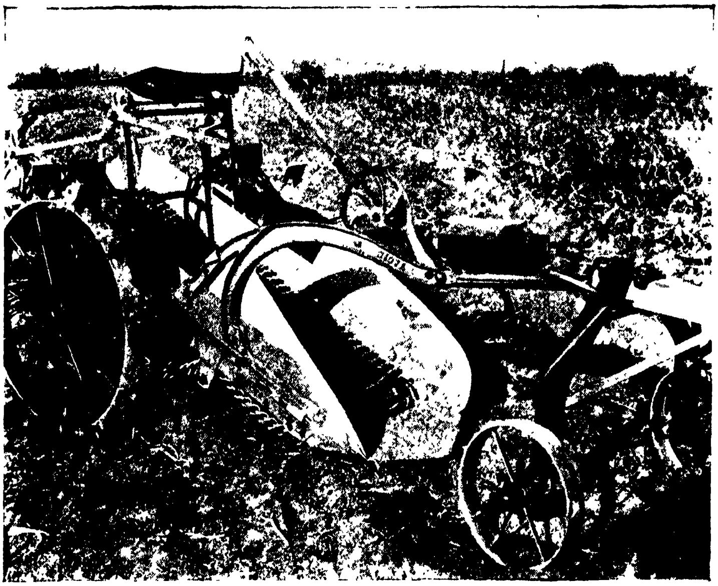

FIG. 3.—Potato Digger (Elevator Class).

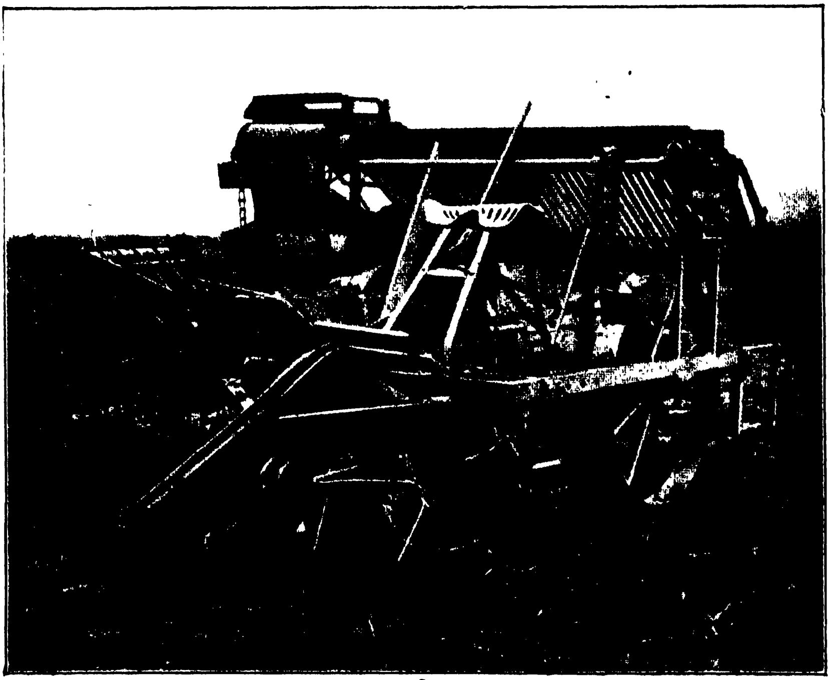

FIG. 4.—Combined Lifting and Bagging Machine.

The Bamlett Machine used the low-speed sprocket, and the net working time for the plot was 17½ minutes, including two short stoppages of a few seconds each to clear the lower edge of the screen of tops and to clean the share. Hardly any choking of the spinner and share was observed. The lifted potatoes were left in a row about 4 ft. in width. A large number of the potatoes were found at the outside of the row where they had been stopped by the screen. This uneven distribution, however, did not handicap the pickers to any great extent, as the tubers were fairly well exposed. Where the tops were strong the screen turned these back over the potatoes at the outer edge of the row, and though in the particular crop used for the test this was not serious, yet in a crop with strong growing tops it might prove troublesome by covering up the tubers.

(2) **Jack's Imperial Potato Raiser (Link Type),** manufactured by Messrs. A. Jack and Sons, Limited, Maybole.

Summary of Results.

		T.	cwt.	qr.	lb.
Total weight lifted	per plot	2	5	2	26
Total weight of harrowings	,,	0	2	1	8
Total weight damaged	,,	0	0	0	15
Estimated weight left in ground ...	,,	0	2	0	8
Total cost per acre		£3 8 6			
Cost per ton of saleable ware and seed lifted ...		£0 10 0			
Total net returns per acre from all tubers raised ...		£40 1 6			
Speed of travel in miles per hour		2·1			
Average distance potatoes thrown		5 ft. 0 in.			
Maximum distance potatoes thrown		12 ft. 0 in.			
Drawbar load in work		473½ lb.			

The action of this machine was more violent than the other types, and although a screen was used which restricted the width of spread of the bulk of the crop to 5 ft., some of the tubers which did not strike the screen were thrown a distance of 12 ft. They were, however, all fairly well exposed for picking. At the third row the screen, which had been set to trail on the ground and was hitched to the tractor to prevent it swinging, became clogged with tops and a short stoppage was necessary to clean and raise it. The net working time for the plot was 27½ minutes. There was a tendency for the tops to cling round the spindle of the machine and the centre of the spinner, and these had to be cleared when opportunity occurred at the headlands. Speed was reduced in the last six rows, which proved more satisfactory as the tubers were then not scattered so far and were also well exposed.

(3) **Jack's Caledonian "A" Potato Raiser (Rotary Type),** manufactured by Messrs. A. Jack and Sons, Limited.

Summary of Results.

		T.	cwt.	qr.	lb.
Total weight lifted	per plot	2	5	2	22
Total weight of harrowings	,,	0	3	1	15
Total weight damaged	,,	0	0	0	24
Estimated weight left in ground ...	,,	0	2	0	8
Total cost per acre		£3 3 9			
Cost per ton of saleable ware and seed lifted ...		£0 9 8			
Total net returns per acre from all tubers raised ...		£40 14 10			
Speed of travel in miles per hour		2·5			
Average distance potatoes thrown		4 ft. 6 in.			
Maximum distance potatoes thrown		6 ft. 0 in.			
Drawbar load in work		441½ lb.			

The action of the Caledonian "A" spinner was less violent than that of the Imperial, but the screen was again necessary to control the spread of the potatoes to 5 ft. The tubers were not, however, quite so well exposed. The tops tended to twine round the spindle as in the case of the Imperial. The net working time for this machine was 25½ minutes for the plot, including one minute for adjusting the screen and digger.

(4) **Jack's Caledonian "B" Potato Raiser (Rotary Type)**, manufactured by Messrs. A. Jack and Sons, Limited.

Summary of Results.		T.	cwt.	qr.	lb.
Total weight lifted	per plot	2	2	1	17
Total weight of harrowings	,,	0	3	0	15
Total weight damaged	,,	0	0	2	4
Estimated weight left in ground ...	,,	0	3	0	12
Total cost per acre		£2 14 10			
Cost per ton of saleable ware and seed lifted ...		£0 9 2			
Total net returns per acre from all tubers lifted ...		£37 17 6			
Speed of travel in miles per hour		3·0			
Average distance potatoes thrown		4 ft. 0 in.			
Maximum distance potatoes thrown		6 ft. 0 in.			
Drawbar load in work		474 lb.			

The net time taken for this plot was 21 minutes, which included two stoppages of 30 and 60 seconds respectively for slight adjustments. As with the "A" type, the spinner action was less violent than the Imperial, but the potatoes were not left so well exposed. The tops, however, were thrown wide and did not tend to twine around the spindle, as was the case with the other machines of this make.

(5) **Martin Potato Digger (Link Type)**, manufactured by Martin's Cultivator Company, Limited, Stamford.

Summary of Results.		T.	cwt.	qr.	lb.
Total weight lifted	per plot	2	3	3	18
Total weight of harrowings	,,	0	3	3	25
Total weight damaged	,,	0	0	1	5
Estimated weight left in ground ...	,,	0	0	1	1
Total cost per acre		£2 13 2			
Cost per ton of saleable ware and seed lifted ...		£0 8 9			
Total net returns per acre from all tubers raised ...		£42 8 10			
Speed of travel in miles per hour		3·1			
Average distance potatoes thrown		4 ft. 3 in.			
Maximum distance potatoes thrown		9 ft. 0 in.			
Drawbar load in work		451 lb.			

The net working time for this plot was 18½ minutes, which included only one stoppage of 10 seconds to clear the share. The potatoes were left in a row having an average width of 4 ft. 3 in., but were not so well exposed as when lifted by other rotary machines. The first row was dug at too great a speed, and consequently the tubers were scattered up to a distance of 9 ft. In the second row, which was dug at a slower speed, the spread was 6 ft. It was found that with a high speed the potatoes were spread up to 9 ft., but were cleanly exposed and were easily gathered. When the speed was lowered a spread of only 5 ft. was obtained, but the potatoes were not fully exposed, particularly on the side of the row next to the machine.

(6) **The Powell Potato Digger (Link Type)**, manufactured by Messrs. Powell Bros., Limited, Wrexham.

Summary of Results.

		T.	cwt.	qr.	lb.
Total weight lifted	per plot	2	5	2	0
Total weight of harrowings	,,	0	2	3	24
Total weight damaged	,,	0	0	0	18
Estimated weight left in ground ...	,,	0	2	0	8
Total cost per acre		£3 14 5			
Cost per ton of saleable ware and seed lifted ...		£0 10 7			
Total net returns per acre from all tubers lifted ...		£39 3 0			
Speed of travel in miles per hour		2·7			
Average distance potatoes thrown		5 ft. 9 in.			
Maximum distance potatoes thrown		12 ft. 0 in.			
Drawbar load in work		363 lb.			

The actual time taken for this plot was 27 minutes, which included seven short stops for cleaning the share. The potatoes were very well exposed, except immediately alongside the path of the machine, and were evenly distributed in a row of from 5-6 ft. wide, but occasional tubers were thrown to a distance of 8 or 10 ft. and even 12 ft. The speed of the machine was reduced for the last seven rows of the plot, and as a consequence the tubers were then thrown up to a distance of about 5 ft., but they were not quite so well exposed as previously.

(7) **Ransomes' No. 12 Potato Digging Machine (Link Type)**, manufactured by Messrs. Ransomes, Sims, and Jefferies, Ltd., Ipswich.

Summary of Results.

		T.	cwt.	qr.	lb.
Total weight lifted	per plot	2	4	3	1
Total weight of harrowings	,,	0	2	2	0
Total weight damaged	,,	0	0	2	4
Estimated weight left in ground ...	,,	0	1	3	8
Total cost per acre		£3 0 6			
Cost per ton of saleable ware and seed lifted ...		£0 9 7			
Total net returns per acre from all tubers raised ...		£40 2 8			
Speed of travel in miles per hour		2·7			
Average distance potatoes thrown		3 ft. 3 in.			
Maximum distance potatoes thrown		4 ft. 0 in.			
Drawbar load in work		455 lb.			

The actual working time of this machine was 22 minutes for the plot, including one stoppage at the end of the first row to lengthen and adjust the draught chain. A slight delay of a few seconds each time was occasioned by the necessity of cleaning the share at the end of each row.

The machine left the tubers well exposed and evenly distributed in a row of from 3 ft. to 3 ft. 6 in. wide, no potatoes being thrown to a greater distance than 4 ft.

(8) **The Hoover Potato Digger (Elevator Type)**, manufactured by the Hoover Manufacturing Co., Avery, Ohio, U.S.A., and represented by British Hart Parr Company, 93, Lincoln Road, Peterborough.

Summary of Results.

		T.	cwt.	qr.	lb.
Total weight lifted	per plot	2	0	3	18
Total weight of harrowings	,,	0	1	2	14
Total weight damaged	,,	0	0	3	27
Estimated weight left in ground ...	,,	0	3	1	13
Total cost per acre		£2 16 1			
Cost per ton of saleable ware and seed lifted ...		£0 9 3			
Total net returns per acre from all tubers lifted ...		£37 11 5			

Speed of travel in miles per hour	2·8
Average width potatoes deposited	1 ft. 6 in.
Drawbar load when lifting	810½ lb.

For this machine a British Wallis Tractor was employed. The net working time for lifting the plot was 24¾ minutes, which included stoppages of 30 seconds for adjusting the shovel, three minutes for re-adjusting the drawbar, and short intervals to relieve the machine of tops which had choked the elevator. The tubers were left in a row varying from 1 ft. 3 in. to 1 ft. 9 in. in width, this narrow width being very convenient for picking. Generally speaking the potatoes were well exposed but some were covered by tops, which were not always thrown clear as is intended by the agitating forks at the top of the elevator of this machine. The manner in which this machine leaves the potatoes renders it essential that the tubers of one row must be picked before another is lifted, otherwise the right hand tractor wheels would travel over the tubers of the previous row. As this machine continues to scatter tubers for some 6-8 ft. after completing the row (the tubers at the end of the row raised by the scoop have to travel up the elevator and drop behind the machine by the shakers) it is advisable to have a clear space at the ends of the drills to facilitate picking and also for the tractor to continue in its line of travel before turning. An advantage with this machine is that the potatoes are left in a narrow row after being raised, with the tops placed to the extreme left but not covering them, which greatly facilitates picking.

(9) **The "Star" Potato Digger**, manufactured by the Cleveland Implement Manufacturing Company Alliance, Ohio, U.S.A., represented by Messrs. Isherwood and Young, 57, Cheapside, E.C.2.

Summary of Results.		T.	cwt.	qr.	lb.
Total weight lifted	per plot	1	19	1	0
Total weight of harrowings	,,	0	3	1	24
Total weight damaged	,,	0	1	2	0
Estimated weight left in ground ...	,,	0	10	1	21
Total cost per acre		£3 9 4			
Cost per ton of saleable ware and seed lifted ...		£0 11 10			
Total net returns per acre from all tubers lifted ...		£26 4 9			
Speed of travel in miles per hour		2·5			
Average width potatoes deposited		1 ft. 6 in.			
Drawbar load when lifting		866 lb.			

The "Star" like the "Hoover" was drawn by the British Wallis Tractor. Its net digging time for the plot was 29½ minutes, including stoppages of 1½ minutes to alter the tractor hitch, of five minutes to adjust the driving chain of the main elevator which had worked off and to clear the tops which clogged the machine, with other short intervals. There were a number of stoppages whilst digging the second half of the plot owing to the scoop being set more deeply in the ridge in order to avoid slicing the potatoes. It is evident that the elevators were not of sufficient width to deal effectively with the amount of soil which was raised when the scoop was set sufficiently deep to raise the whole of the tubers of the crop.

The potatoes were left in a narrow row of about 1 ft. 6 in. in width in the rear and in the line of travel of the machine, but were not well exposed as a considerable amount of soil and tops dropped with and on top of them. Consequently more pickers had to be employed than with the Hoover.

(10) **The Haug Combined Lifting and Bagging Machine**: manufacturers' agent, Mr. Th. Jespersen, c/o Messrs. Baddon and Arton. 45, Chancery Lane, London, W.C.2.

Summary of Results.

	T.	cwt.	qr.	lb.
Total weight lifted	2	6	0	22
Total weight of harrowings	0	0	3	14
Total weight damaged	0	3	0	20
Estimated weight left in ground	0	4	1	18
Total cost per acre	£4	10	1	
Cost per ton of saleable ware and seed lifted ...	£0	13	2	
Total net returns per acre from all tubers lifted ...	£32	1	1	
Drawbar load when lifting	1,293 lb.			

The Haug Machine only lifted one half of the plot allotted to it, but the figures have been doubled to permit of easier comparison. The machine, which was in an experimental stage, proved quite unsuitable for English conditions, and at the end of six rows the owner withdrew it from the investigation.

Conclusions.—Whilst it is not possible to base exact conclusions on some of the data contained in the Report, it is possible to make some general deductions so far as groups of machines are concerned.

Plough Group.—The investigation of 1916 showed that the use of an ordinary potato-lifting plough resulted in a saving of £4 10s. an acre as compared with hand forking and it would appear that a grower of at least one acre of potatoes would be well advised to use such an implement rather than hand labour for lifting the crop.

Rotary Group.—In these trials the marked superiority of this type of machine over the other types is shown (1) by the fact that the net profit realisable per acre from the potato field in question amounted to an average of £39 19s. 10d. when lifted by the rotary machine; £31 18s. 2d. by the machines of the elevator type; and £32 1s. 1d. when lifted by the combined type. (2) by the fact that when the ten machines are arranged in order of merit according to costs, the seven machines of the rotary type come first, and when arranged in order of merit according to their mechanical efficiency the first six are all of the rotary type. The minimum area upon which the rotary type can be economically employed is about 5 acres.

Elevator Type.—All the conditions in the test were ideal for the efficient working of this type and had the soil conditions been only slightly worse the performances would have been still poorer. The only advantageous point in these machines is the manner in which the potatoes are deposited after lifting, *i.e.*, in a very narrow row. The general performance, however, reflects badly on this type, when the quantity of potatoes left in

TABLE I.

COMPARATIVE PERFORMANCE AND COST.

—	Ransomes	Bamlett	Powell	Martin	Jack's Imperial	Cale-donian A	Cale-donian B	Hoover	Star	Haug
	T. C. Q.	T. C. Q.	T. C. Q.	T. C. Q.	T. C Q.	T. C. Q.	T. C. Q.	T. C. Q.	T. C. Q.	T. C. Q.
Total weight lifted	2 4 0	2 4 0	2 5 2	2 3 3½	2 5 3	2 5 3	2 2 2	2 0 3½	1 19 1	2 6 1
,, ,, harrowings	2 2	3 0	3 0	4 0	2 1¾	3 1¼	3 0½	1 2½	3 2	3½
,, ,, damaged	2¼	1 0	0 ½	1¼	0½	1	2	1 0	1 2	3 1
,, ,, left in ground ...	1 3½	2 3	2 0½	1	2 0½	2 0½	3 0¼	3 1½	10 2	4 2
Time lifting in minutes ...	22	17½	27	18½	27½	25½	21	24⅔	29½	54
,, picking ,, ,, ...	29	22	35	24	31	28	24	27	34	56
,, harrowing ,, ,, ...	39	42	40	38	40	40	35	37	35	36
No. of pickers	12	14	14	14	14	14	14	11	12	6
Average spread of potatoes... ...	3¼ ft.	4¼ ft.	5¾ ft.	4¼ ft.	5 ft.	4½ ft.	4 ft.	1½ ft.	1½ ft.	—
Acres lifted per day...	4	5	3·2	4·7	3·2	3·4	4·2	3·5	3	1·6
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Cost per acre...	3 0 6	2 11 7	3 14 5	2 13 2	3 8 6	3 3 9	2 14 10	2 16 0	3 9 4	4 10 1
Cost per ton of Saleable Ware and Seed	9 7	8 9	10 7	8 9	10 0	9 8	9 2	9 3	11 10	13 2
Net profit realisable per acre ...	40 2 8	39 10 9	39 3 0	42 8 10	40 1 6	40 14 10	37 17 6	37 11 8	26 4 9	32 1 1

Average Net Profit Realisable per acre when lifted by (*a*) Rotary Machines £39 19 10
(*b*) Elevator Machines £31 18 2
(*c*) Combined Type £32 1 1

the ground, the percentage damaged, and the quantity of harrowings are examined. The cost of picking constitutes, on the average, well over 40 per cent. of the total cost of lifting, and when the results obtained by this type are examined, it will be seen that the cost of picking alone falls considerably below the corresponding figures for the rotary type of machine. The tractor load is heavy and out of proportion to the work done in comparison with the rotary type. The shovel does not avoid damaging the potatoes and is certainly no more effective in lifting the drill than the share and revolving tines of rotary machines.

The Combined Type.—This type offers a very wide and extended field of investigation and the high cost of bagging and picking with machines at present employed shows that there is scope for any device which will displace hand labour. For every £5 15s. expended in lifting and sorting the crop, £4 was expended in picking, sorting and bagging. If these operations can be dispensed with by the use of the combined type there is a possibility of saving up to 70 per cent. of the cost of harvesting and marketing potatoes. No machine of this type has yet been sufficiently developed to justify its use.

Finally, it must be remembered that the results set out above were obtained for machines working under good conditions of soil and weather for a few days only and that due allowance must be made for these facts in judging the suitability of a machine or method for different soil or climatic conditions. It may be accepted, however, that under worse conditions the more complicated the machine the greater would be its handicap and this would increase as the working conditions became worse. This might result in a potato-lifting plough, for instance, being more economical on very heavy land or under adverse weather conditions than a rotary machine for an area in excess of five acres, but it is inconceivable that a machine of the elevator or combined type would be successful in unfavourable conditions which had proved too much for a rotary machine. In extreme cases it might be best to use a ridging plough or even hand labour.

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WILD ANIMALS OF THE FARM: THE WILD RABBIT.

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THERE seems to be good reason for believing that the Wild Rabbit lived in England before the Great Ice Age, that it was exterminated during that time of sifting, and that it was re-introduced—probably from the Mediterranean region or Spain. There is no doubt that its introduction into Scotland and Ireland is comparatively recent. Indeed, it was not known in Scotland before the thirteenth century, and there are many places north of the Tay which it did not reach till the nineteenth. But while it does not like severe cold, as in Scandinavia, it has an adaptable constitution and flourishes only too well in a great variety of places from Ireland to Australia.

Enemies.—The Wild Rabbit has no end of enemies, from man to rats, and yet it holds its own with ease. Against it are foxes, stoats, badgers, cats, hawks and owls, ravens and crows, and more besides, yet its ranks are not thinned. In what ways does it secure survival? Not because of its wits, for it is not a clever creature, and its brain is very smooth. Not because of its weapons, for its teeth are not suitable for biting (though it occasionally bites both man and dog in the extreme of its desperation), and it cannot give such a formidable back-kick as the hare is able to deliver.

Fertility.—The first reason for the rabbit's success is its fertility. It is ready to breed at six months; it may have six litters between February and September; the period of ante-natal life is just about four weeks; there may be five to eight young ones in a litter. There is often considerable infantile mortality, for if the burrow gets very damp some of the young ones are apt to die of paralysis, and there is often the chance of a fatal visit from a brown rat. After they emerge into the open the young rabbits are often picked off before they learn to find their way about. Counter-balancing all these chances of death there is the prodigious fertility.

Appetite.—A second reason for the rabbit's success is its catholicity of appetite, and this rivalry touches man on the raw. For besides grass which is the staple food, rabbits are fond of cereals, turnips, bark, and garden vegetables. They eat the young

shoots of furze and bracken, and, from the agricultural point of view, that is to the plus side of the account; but everyone is aware of their very serious depredations in farm and garden. There are many curiosities of diet, *e.g.*, birch leaves, laurel bark, and rhododendron, but these are neither here nor there except in indicating that the rabbit has many resources. A little detail which is quite characteristic of the difference between rabbit and hare is that the rabbit eats the whole turnip, whereas its cousin—a dainty feeder—leaves the rind.

Burrowing Habits.—A third factor in the rabbit's survival is to be found in its burrowing habits. When animals long ago left the water and took to terrestrial life, they left behind them the freedom of movement which aquatic conditions afford, and they were restricted to movement in one plane—the surface of the earth. This restriction involved increased danger, which had to be met by greater rapidity and precision of movements, implying improvements in the nervous system and the musculature. But another way out of the difficulty was to gain the power of flight as birds did, or to become arboreal as some squirrels have done, or to return secondarily to the water as in the case of otters, or to become burrowers like the rabbits. The burrow may be only a yard deep, but it is often much more; it may have various branches and more than one doorway. It is a life-saving retreat.

A Twilight Feeder.—Another factor in success is in itself a confession of relative failure: the rabbit is in great part a twilight animal. Except when there is a tradition of great safety, rabbits tend to rest through the day and to reserve their feeding and their frolics for the dusk. It is then that the white tail, flicked up by the seniors, gives the inexperienced youngsters a lead in finding the burrow as quickly as possible. In the darkness there is also advantage in having well-trodden paths or runways, though man utilises these in setting snares.

Sociability.—Another useful quality is sociability. Rabbits are in this respect to the hare as rooks to a crow. They are pleasantly playful and the social note is sounded in the quaint danger-signal which they make by thumping on the ground with their hind legs. Compared with most gregarious animals, they have little voice, for it hardly rises above a whisper on ordinary occasions. They utter a grunt of contentment when pleased and this is sometimes used as a call-note. Their scream of terror when the stoat overtakes them is of course pathological.

Care of the Young.—Yet another factor in survival is the care of the young. The nest at the far end of the burrow is made cosy with soft hair pulled by the mother from her coat. The young ones, blind for eleven days, with closed ears for twelve, and quite naked to start with, are nursed very faithfully; a dead one is removed and hidden; the door of the burrow may be closed up when the mother has to go out.

Timid as she is, the mother will occasionally fight for her offspring. She will move them from a place of danger to a place of supposed safety, just as a cat will her kittens. And very important is the period of education which begins when the young are able to leave the burrow. They have a great deal to learn and their mother is a good teacher.

It seemed of interest to discuss the Wild Rabbit from this particular point of view—how does it survive? The answers are because it is prolific, with a wide range of appetite, a burrower, crepuscular, sociable, maternal, and a good teacher. Of course that is not quite all—there is the keen sense of smell, for instance—but it must suffice; for there are some other questions to be considered.

Promiscuous Pairing.—There are well-authenticated cases where a pair of rabbits keep to monogamy for a year at least, but that is not the way with the majority. Polygamous is too mild a word; promiscuity is the rule. In this connection we must notice Rodier's plan for dealing with the Australian rabbit pest. He suggested that does should be killed in as large numbers as possible, but no bucks. The *local* result was that the bucks killed the helpless young, and the polyandry that set in became so intense that the females perished in large numbers. They were persecuted to death by the demands of the bucks. How far the plan has worked over large areas we do not know.

Rabbits were introduced to Australia about 1850, and in the absence of their usual enemies they multiplied exceedingly, turning enormous tracts of useful soil into desert. Many checks have been tried, but the rate of multiplication seems to defy all expedients The only hope of permanent relief, and that not a very brilliant one, is the increase of the agricultural population. But it is almost a vicious circle.

Teeth.—A typical Wild Rabbit is about seventeen inches long and three pounds in weight. Like the hare, and unlike other rodents, it has two pairs of upper incisors, the smaller pair behind the larger. On the lower jaw there is as usual a single pair of incisors. These front teeth go on growing persistently—

an adaptation to counteract the continual wearing away at the chisel-edged tips.

It occasionally happens that the upper and lower front teeth do not meet one another with precision, and then the persistent growth of the teeth may prove fatal, though it is extraordinary what a rabbit can stand in the way of dental malformation. The chisel-edge is produced automatically because the very hard enamel is confined to the front and does not wear so quickly as the relatively softer ivory behind. In the process of eating it may be observed that the lower incisors work against the back part of the front upper incisors, and on the surface of the blunt hidden second pair of incisors. There are of course no canines, and the furred sides of the cheeks project into the mouth between the incisors and the back teeth, which are suited for grinding. In rodents that gnaw much more than they wish to swallow, the non-edible material does not get past the front part of the mouth. The munching movements in eating seem to have given rise to a belief among country people that the rabbit chews the cud.

The Fur.—It is interesting to peer into the grizzled greyish-brown fur of the Wild Rabbit to see what a subtle mixture it is. Students of heredity have shown that numerous "factors" go to the making up of this really beautiful fur, and that the dropping out of one or several of these in the maturing of the germ-cells may result in a colour-variety. So have arisen in domestication the blacks and whites, yellows and "blues," and other colours—all derived from the Wild Rabbit's fur. Should these varieties, which man keeps apart, inter-breed, there must eventually be in the progeny a return to the Wild Rabbit type of coloration. Items that have been separated out come together again. The Wild Rabbit has evidently great possibilities of change, for it has supplied the material out of which man has established Angoras, Lop-Ears, "Belgian Hares," Flemish Giants, and so forth. Small variations occur in natural conditions, but they come to nothing, apparently because the Wild Rabbit is well adapted to survive just as it is at present.

Injury and Use.—The circle of the Wild Rabbit's life cuts into man's. They do great damage by devouring field-crops and garden-produce. They often smother good grass with the material thrown out from their burrows. They foul the grass so that sheep will not eat it, and the hare also sniffs and turns away. They destroy young trees by cutting off a ring of bark a little above the ground. There is, indeed, something on the plus side. They afford useful fur and palatable flesh; we have noticed

that they check the spreading of gorse and bracken; and they make the most perfect golfing turf in the world. But even their best friends will admit that Wild Rabbits frequently outrun all reasonable bounds.

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THE ECONOMICS OF WINTER AND SUMMER MILK PRODUCTION.

JAMES WYLLIE, B.Sc., N.D.A. (Hons.), N.D.D.

THE production of milk in this country is carried on under highly diverse conditions which vary from farm to farm as well as from district to district; there is also considerable variation in the method of disposing of the milk. At the one extreme we have the "town-dairy," where all the cows are purchased, kept for only one lactation and then sold to the butcher, the milk being sold direct to the consumer; at the other, the purely cheese-making farm, where all the cows are home-bred, kept for three to six lactations and then sold, the milk being made almost entirely into cheese. In the former case, all the feeding stuffs are purchased and the manure sold; in the latter, the greater part of the food is home-grown and the manure is returned to the land. In the former, the cows calve, or are purchased newly calved, so as to maintain a fairly uniform monthly output throughout the year; in the latter, all the cows calve in the spring, there is a "flush" of milk for about three months after calving and practically none for about three months in the winter.

Systems of Milk Production and Disposal.—Apart from town-dairying, the systems of milk production may be classified as follows:—

Group A. Milk Selling.—(1) Cows calve all the year round and the monthly output of milk is fairly uniform, but highest during the months of April to July. (2) Cows calve chiefly in the spring, and the monthly output is much greater from April to July than during the rest of the year.

Group B. Milk Selling and Cheese-making.—(1) Cheese made or milk sold according to economic conditions (relative prices of milk, cheese, pigs, etc.). (2) Cheese made from March or April to September or October, and milk sold during the rest of the year. In both cases, the cows calve chiefly in the spring, and the monthly output of milk during the winter months is comparatively small.

Group C. Butter-making.—Most of the milk is made into butter.

Group D. Cheese-making.—Most of the milk is made into cheese (These last two groups are relatively unimportant).

Further, the milk that is sold by the farmer may be disposed of (*a*) direct to the consumer, (*b*) to a retailer, (*c*) to a wholesaler, or (*d*) to a creamery, milk depot or milk factory. In the first three cases, most of the milk will be consumed as whole or "fresh" milk, but in the last case it may be re-sold to a retailer or wholesaler for consumption as fresh milk or made into cream, butter, cheese, dried or condensed milk, etc.

It should also be remembered that from the economic point of view, cheese-making and the breeding and feeding of pigs are intimately associated, while the same applies to butter-making and the sale of buttermilk, or the rearing of calves and pigs. Further, the price of fresh milk—and therefore its production—is affected by the imports of butter, cheese, dried and condensed milk.

The above classification is, however, by no means rigid, and is much less so than it was even twenty years ago, *i.e.*, the farmer has a greater choice as to how he can best dispose of his milk and therefore as to the system which he can most profitably follow. In the main, this is due to the introduction of (1) creameries, milk depots and milk factories, (2) motor transport* and improved railway milk vans, and (3) refrigerators and pasteurising plants. The general effect of these innovations is to increase the potential supply of fresh milk, not only absolutely but also relative to the total output.

Irregular Output of Milk.—In view of such wide variations, it is not surprising that the organisation of the milk industry upon national lines involves numerous problems which so far have not been successfully solved. Perhaps the fundamental difficulty arises out of the irregularity in the monthly output—an irregularity the degree of which varies considerably from district to district and from farm to farm in the same district. Roughly speaking, what happens at present is a glut or surplus of milk in the late spring and summer months, accompanied by relatively low prices for fresh milk, and a shortage during the winter months, accompanied by relatively high prices.

Until recently, the main efforts have been directed towards the *utilisation* of the surplus production by means of creameries, milk factories, etc., but it would appear that in the agreements made in the autumn of 1922 between the producers' and

* Compare *Scottish Farmer*, 11th November, 1922, p. 1386 :—"Motor traction has contributed greatly to the modification of dairying methods in Avondale. Hardly a cheese-making dairy in the whole area now. Milk nearly all goes to Glasgow by motor."

the distributors' organisations both in England and in Scotland, direct encouragement is given towards the *removal* of the surplus by transferring milk to the winter months, *i.e.*, one object of these agreements is to obtain a more regular output throughout the year. It is commonly stated that the consumption of fresh milk in this country is much too low for the national welfare, and if this be so it seems rather strange that we should hear so much about surplus production.

Actual statistical evidence of this irregularity in output is somewhat incomplete, although its existence cannot be questioned: indeed, there is a tendency to look upon it as one of the "incurable ills" of the milk producer. In order to give some idea as to the degree of irregularity which obtains the following data may be quoted:—

VARIATION IN MONTHLY OUTPUT OF MILK.

(1) *Scottish Milk Report.**

Period (4 weeks) 1920-21	*Per cent. of Total Output.*	
May 16—June 12	8·9	Aver. per four weeks 8·56
June 13—July 10	9·8	
July 11—Aug. 7	8·9	
Aug. 8—Sept. 4	8·0	
Sept. 5—Oct. 2	7·2	
Oct. 3—Oct. 30	6·7	Aver. per four weeks 6·52
Oct. 31—Nov. 27	6·4	
Nov. 28—Dec. 25	6·4	
Dec. 26—Jan. 22	6·6	
Jan. 23—Feb. 19	7·1	Aver. per four weeks 7·78
Feb. 20—Mar. 19	7·6	
May 20—Apr. 16	7·9	
Apr. 17—May 14	8·5	
	100·0	

Astor Milk Committee Report.†

Month.	*Per cent. of Total Output.*	
May	10·8	
June	11·8	
July	10·3	
Aug.	9·8	
		42·7
Sept.	9·1	
Oct.	8·3	
Nov.	7·1	
Dec.	5·9	
		30·4
Jan.	5·9	
Feb.	6·0	
Mar.	6·9	
April	8·1	
		26·9
		100·0

In the first case, the data were obtained by the writer in an investigation into the cost of milk production in Scotland for the year ended 14th May, 1921, and are the average results from thirty-two farms, nearly all of which belonged to Group A (1) above. These are therefore actual results for these farms for that year. In the second case, the data are taken from the Astor Milk Committee Report and are estimates, based upon all the evidence available, of the relative monthly output for the whole of Great Britain during the years 1917-18. It will be noticed that, as would be expected, the variation is

* Report to Board of Agriculture for Scotland on an Investigation into the Cost of Milk Production.

† Final Report of Committee on the Production and Distribution of Milk. (Cmd. 438, 1919).

much greater in the second than in the first set of figures. Further, the final report of the Travelling Milk Commission* contains the results of a census of milk production taken by the Ministry of Food for the week ended 2nd June, 1918, and again for the week ended 7th December, 1918. In the week first mentioned the total milk production for Great Britain was estimated to be about 27.8 million gallons whereas in the second week it was only about 13.7 million gallons.

By way of contrast, take an example from Denmark. In 1912-13 out of the total of 34,217 cows included in a certain investigation, 33 per cent. calved during October to December, 31 per cent. from January to March, 19 per cent. from April to June and 17 per cent. from July to September.†

Causes of Heavy Summer Production.—If then we are correct in our diagnosis of "irregular output" as the primary disease of the milk industry, the next step is to look for the cause, after which it will be possible to decide to what extent the disease can be eradicated, or at least alleviated.

Many explanations can be put forward—connected with the climate, soil, size of farm, labour supply, marketing facilities, likings of the farmer and so on—but in the last resort the fundamental cause undoubtedly is that each farmer follows that system of production which he believes enables him to obtain the maximum total profit from his farm. There is no reason to think that farmers have a rooted aversion to winter as against summer milk production, although it may be said that there is a widespread opinion that "winter milk" seldom pays and that the all-the-year-round producer makes all his profit during the grazing season.

Before any marked change towards increased winter production (and a more uniform monthly output) will be made, farmers must be satisfied (1) that the change is practicable *i.e.*, from the point of view of labour supply, byre accommodation, sanitary conditions, etc., and (2) that it is likely to result in an increase in the total profit from the farm. Let us examine this last point a little closer.

A readjustment in the monthly output, if upon any considerable scale, would no doubt affect the relative monthly prices for fresh milk, in accordance with the ordinary laws of supply and demand. Thus, an increased winter output would be likely

* Cmd. 233, 1919.

† Quoted in *Journal Department of Agriculture and Technical Instruction for Ireland*, Vol. XIV, No. 4, p. 727.

to cause some lowering in the winter milk prices, while a reduced summer production might conceivably result in somewhat higher prices. Since, however, milk prices in this country are indirectly influenced by the current prices of imported cheese and tinned milks, it must be confessed that the ultimate results under this head are highly problematical. The go-ahead farmer, however, will not fail to notice that for some time at least it may be possible for him to increase his winter milk output very considerably without any reduction in price taking place. In favour of winter milk production, it is urged that a cow capable of giving 700 gallons of milk after a spring calving would be capable of at least 800 gallons after an autumn calving —for reasons into which we need not enter here. The data on this point are numerous and conclusive.* Further, the autumn calver produces a greater proportion of her milk during the months of highest prices than the spring calver. Thus, we might have :—

	Gals.		*Per Gal.*	*Total.* £	*s.*	*d.*
Spring calver gives	700	at	1/2	40	16	8
Same cow calving in autumn gives	800	at	1/4	53	6	8
Difference in favour of autumn calver				£12	10	0

These figures are only illustrative but they serve to emphasize two important points which are apt to be overlooked or ignored. On the other hand, the autumn calving cow requires, of course, more liberal winter feeding than the spring calver. (Other costs—labour, general expenses, etc.—may also be a little higher, but for the present purpose it is sufficient to deal with the cost of feeding). Now it is generally agreed that, under ordinary conditions, winter milk production is not likely to be profitable unless there is a good supply of home-grown fodder, and of roots or silage, although the roots or silage can be replaced to a certain extent by wet brewers' and distillers' grains. If cheap home-grown oats and beans are also available so much the better. Here we can distinguish three typical cases, viz. :—

(*a*) On what are at present purely or mainly "grass farms," winter milk production would involve a radical change in the method of handling the land.

(*b*) On many farms, plenty of fodder and roots are available,

* See, for example, *Journal of the Department of Agriculture and Technical Instruction for Ireland*, Vol. XIV, No. 4, and Vol. XVII, No. 2; Bull. No. XXV. Agricultural Department of University College, Reading. Compare *Journal R.A.S.E.*, 1912, p. 171, and Trans. Highland and Agric. Soc., 1919, p. 250.

but these are fed largely to dry cows which are due to calve from March onwards. In this case, all that would be necessary for an increased output of winter milk would be a reorganisation of the milk production department.

(c) On other farms, again, the fodder and roots are fed to sheep and fattening cattle, as well as to dairy cows, or are partly fed and partly sold. In this case, it is a question as to the most profitable way of disposing of these crops.

In general, the change towards increased winter milk production could be most readily effected in case (b). In case (c) the question is not so much whether an increased output of winter milk would result in an increase in the total profit from milk, as whether such a change would bring about an increase in the total profit from the whole farm; it must always be kept in mind that the goal of the farmer is the maximum possible profit from the farm as a whole rather than from any particular department. Looked at from this angle, the problem is by no means so simple as at first sight it appears to be, and its accurate solution in many cases involves very careful and somewhat detailed accounting records.

At the same time, the general tendency is to lay too much stress upon the extra expense in feeding cows which are in full milk during the winter months, and to overlook or to minimise the increased yields and higher milk prices which are obtained from autumn as against spring calvers. There is also a tendency to underestimate the cost of summer grazing, especially on temporary or rotation pastures, of which rent and rates may form no more than 50 per cent. instead of almost the whole as is commonly reckoned. These tendencies are no doubt partly responsible for the existing prejudice against winter dairying. An old Scotch saying has it that, "he who counts the cost will never yoke the plough," but the fact that farmers have gone on ploughing rather suggests that the cost was not *correctly* counted. It is anything but a simple matter to calculate accurately the relative costs of production of winter and summer milk, and haphazard calculations are almost certain to be very wide of the mark.

Returns from Summer and Winter Milk.—The relative profits from winter and summer milk production will depend to a certain extent upon the relative market prices for winter and summer milk, and it is perhaps not sufficiently realised that if the cost of production and selling price per gallon of winter milk are both 50 per cent. higher than those of summer milk,

then the net profit per gallon will also be 50 per cent. higher, so that we might have:—

	Cost of Production.	Selling Price.	Net Profit.
	d.	d.	
Winter milk per gal.... ...	18	21	*Threepence.*
Summer milk „ „	12	14	*Twopence.*

It is clear that an increased output of winter milk may be obtained either by increasing the number of cows in the herd by the introduction of autumn calvers, or simply by increasing the proportion of autumn calvers in the number of cows already in the herd. In the majority of cases, the second method will probably be the more practicable, but an increase of arable dairying, which may take place under existing economic conditions, might very well take the form of relatively high winter milk production.

Now suppose that we are right in assuming that farmers do not go in more extensively for winter milk production chiefly because they think it is less profitable than summer milk production, what evidence can we produce to the contrary? Unfortunately, direct evidence, based upon actual experience, is very scanty, and however easy it might be to make out a strong "theoretical case" in favour of winter milk it is unlikely that such proof would carry much weight with the practical farmer.

A Scottish Investigation.—In the Scottish investigation conducted by the writer, which has already been referred to, complete data of both costs and returns were obtained from 28 farms distributed throughout Scotland, but chiefly in the south-west. On six of these farms the milk was retailed; on the remaining twenty-two it was sold wholesale, sixteen being farms with "breeding stocks" (*i.e.*, all cows home-bred) and six farms with "flying stocks" (*i.e.*, all cows purchased). We shall confine our attention to these twenty-two farms as being more representative of the milk production industry in general. "Producer-retailers" are in a class by themselves.

Before giving a summary of the results obtained, it should be pointed out (1) that the year was divided into (*a*) the "summer" or grazing period from 16th May, 1920, to 2nd October, 1920 (20 weeks), and (*b*) the "winter" or house-feeding period from 3rd October, 1920, to 14th May, 1921 (32 weeks), so that the terms "summer" and "winter" have here a special and definite meaning; (2) that nearly all these twenty-two farmers were all-the-year-round producers; (3) that all the home-grown foods consumed by the cows were charged at market prices so that milk production was made to stand on its own legs; (4) that the cost of keeping the cows during the dry period was apportioned over both the summer and the winter milk, *e.g.*, spring

calvers were depreciated in value between the stocktakings at 16th May and 2nd October, 1920, and appreciated between 2nd October, 1920, and 14th May, 1921; (5) that the results for the summer period were completely tabulated and summarised long before those for the winter period were known, *i.e.*, the results for the two periods were obtained independently; (6) that the determination of the relative profits from the two periods was not one of the immediate objects of the investigation; in fact, this is the first occasion on which the results have been discussed from that standpoint; and (7) that the farms in question are thoroughly typical of the higher-grade farms of this class in Scotland.

The following table summarises the results from the present point of view:—

Item.	*Breeding Stocks—16 farms.*			*Flying Stocks—6 farms.*		
	Summer.	Winter.	Year.	Summer.	Winter.	Year.
	d.	d.	d.	d.	d.	d.
Aver. Production Cost per gal. ...	12·62	20·39	17·10	17·43	22·28	20·27
„ Delivery „ „ ...	1·13	1·43	1·30	1·27	1·34	1·32
„ Total „ „ ...	13·75	21·82	18·40	18·70	23·62	21·59
„ Price per gal.	17·68	27·91	23·59	20·70	30·17	26·28
„ *Net Profit* per gal.... ...	3·93	6·12	5·19	2·00	6·55	4·69
Total Milk Produced—gal. ...	133,553	181,229	314,782	41,793	59,506	101,299
Aver. Weekly Production—gal.	6,678	5,663	6.053	2,090	1,860	1,948
Relative Production	100	85	—	100	89	—
No. of farms where net profit is higher in winter than in summer		11				

From this table it appears (1) that on these farms the average weekly output during the winter period was from 10 to 15 per cent. less than in the summer period; in a few cases it was actually higher in the winter than in the summer period; in others it was as much as 25 per cent. less;* (2) with the breeding stocks the milk produced during the winter period left a net profit of nearly 2¼d. per gallon more than that of the summer period, while with the flying stocks the difference was nearly 5d. per gallon in favour of the winter period; and (3) that out of the 22 cases 15 showed a higher net profit per gallon in the winter than in the summer period while 7 showed the opposite result.

It should be further noticed that in the case of the breeding stocks the total cost per gallon was 59 per cent. higher in the winter than in the summer period, while the average price per

* It was also found that, with the sixteen breeding stocks, for every 100 gal. of milk per week produced during the 16 weeks from 3rd October to 25th December, 1920, 127 gal. were produced during the 20 weeks from 16th May to 2nd October, 1920, and 108 gal. from 26th December, 1920, to 14th May, 1921.

gallon was 58 per cent. higher, with the result that the net profit per gallon in the winter exceeded that of the summer period by 56 per cent. In the case of the flying stocks the corresponding figures are 26 per cent., 46 per cent. and 227 per cent., respectively.

Is increased Winter Milk Production Profitable?—It follows from the above that if the average cost per gallon of winter milk production were to fall to a greater extent than that of the summer milk (as indeed has probably happened since 1920-21), and if the same ratio were maintained between the summer and winter period prices, then the advantage of winter milk production would be still greater than is here indicated. In this connection, it may be pointed out that, in the recent agreement between producers' and distributors' organisations in England and Wales for the year ending Michaelmas, 1923, the price obtained by those farmers who maintain as uniform a monthly output as in the case of the above sixteen breeding stocks, will be fully 50 per cent. higher in the winter than in the summer period (as above defined).

These results, then, provide an effective answer to the question: In all-the-year-round production as carried on under existing conditions, does the production of milk during the winter or house-feeding period pay at least as well as summer production? We are bound to say that there seems no reason why it should not, and it may be further stated that a detailed examination of the records of the above farms showed that the milk produced during the months of November to February was at least as profitable per gallon as that produced during March, April and the first half of May.

We have still to answer the question: Would it be likely to pay the farmer, who has been in the habit of producing most of his milk in the late spring and summer months, to arrange to calve more cows in the autumn and fewer in the spring so as to increase the production during November to March and decrease it during April to July, *i.e.*, so as to obtain a more uniform monthly output?

Obviously, no definite answer can be given, for much will depend upon the circumstances already mentioned, but reference may be made to the results from experiments carried out under the auspices of the Irish Department of Agriculture in furtherance of a campaign for increased "winter-dairying"—in 1909, a census of 63 typical Irish creameries showed that

70 per cent. of the annual output was produced from May to September and only 10 per cent. from December to March.*

A Trial in Ireland.—The first series of experiments was conducted at two centres in County Cork during the years 1907-08.† At each centre 5 cows calved in the autumn (November, 1907) and 5 in the spring (March and April, 1908), careful records of feeding, milk yield, quality of milk, etc., being kept for each cow for the complete year after the date of calving. A profit and loss account for each lot was finally drawn up.

At each centre the autumn calvers, chiefly on account of the better yields and higher average prices for the milk, and in spite of the increased cost of feeding, etc., gave a higher net profit than the spring calvers—to the extent of £2 10s. 1d. per head in one case and of £1 4s. 1d. per head in the other. In both cases, the experimenters considered that a clear case for increased winter dairying had been made out. Other experiments in County Cork‡ and also in County Down‡ gave substantially the same results.

It is true that in certain respects these experiments are open to criticism, but in the main the results certainly go to show that under suitable conditions an increase of winter dairying in Ireland would be likely to prove highly advantageous.

Similar experiments to the above have not, so far as the writer is aware, been carried out in Great Britain, but in an analysis of the data on the cost of food in the production of milk obtained by Crowther and Ruston in the Yorkshire investigations, Wilson§ arrived at the conclusion "that cows with similar yields produce milk at similar costs, irrespective of their times of calving," for the reason "that the winter-fed cow gives enough extra milk to make up for the extra costs."

Winter Milk Production in Denmark.—In Denmark, as indicated by the data already given, winter milk production is very extensively practised, partly with the object of maintaining a uniform output of butter, etc., all the year round. In that country, the important part which root crops play in successful winter dairying is shown by the fact that the area under mangolds, swedes and turnips has increased from only 95,000 acres in 1888 up to 330,000 acres in 1901 and 678,000 in 1919; in 1918 nearly 10 per cent. of the total acreage of crops

* *Jour. of the Dept. of Agric. and Tech. Instr. for Ireland*, Vol. XII, No. 2.
† Ibid, Vol. IX, No. 4.
‡ Ibid, Vol. XI, No. 1; Vol. X, No. 1.
§ Ibid, Vol. XVII, No. 2, pp. 223–4.

and grass was under these crops, compared with only a little over 5 per cent. in Great Britain.* It may well be argued that what is possible in Denmark must also be possible in many districts in both England and Scotland.

It is freely recognised that winter milk production cannot be successfully practised under all conditions, and also that a sudden and widespread change of policy on the part of milk producers would probably lead to disastrous results; but in the writer's opinion there is no doubt whatever that a gradual levelling up of the monthly milk output in Great Britain would prove beneficial alike to the producer, the distributor and the consumer. All the evidence available supports this view, and it is probable that experience of the price-agreements above referred to will go far to confirm it. Conditions pertaining to both production and consumption have changed considerably in the last twenty years, but producers have been somewhat slow to modify their methods of production accordingly. It is hoped that this article may serve to direct attention to what is undoubtedly one of the most important aspects of economic milk production.

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GLIMPSES OF AMERICAN HORTICULTURE.

I.

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IMPRESSIONS of interest and of value to cultivators at home should be gained as the result of a visit to the United States of America, especially when it embraces visits to many State Horticultural Stations, as well as to commercial plantations scattered in various States necessitating travelling nearly 4,000 miles. When one proceeds to sort out the impressions gained, however, there is a danger of creating the idea that one feels entitled, after a few weeks of observation of so vast an area, to dogmatise on its characteristics and sum up its features.

The intention is not to dogmatise but to give a few impressions collated from notes taken at the time, in the hope that they may be of interest, or may furnish some useful information. There are circumstances which appear to owe their existence

* *Forage Crops in Denmark*, Harald Faber, pp. 28, 29.

to the character of the American people, who seem possessed of a fever, induced by a reaction to the many-voiced call of opportunity and the hustle and haste of a new country with almost limitless potentialities, to exploit the chance of to-day without waiting to consider what will be the effect on to-morrow. This attitude of mind may account for the American neglect of gardens, for hardly any attempt seems to have been made to cultivate the garden such as British people know it. The land attached to villas and cottages in the suburbs remains unfenced with the lawn sloping direct up from the side walk of the road. The lawn, if the spare piece of land covered with weeds can be so described, is curiously enough mown with scrupulous attention. Vegetable gardens are but rarely seen, and where they are it may be taken for granted they are cultivated by Englishmen or Scotchmen. Of flower culture in small gardens there is little or none, yet the American is undoubtedly a flower lover, and is willing to pay high prices to gratify his taste.

In Washington at the end of May gladioli were making 3 and 4 dollars a dozen, single blooms of Cattleya were selling for 4 dollars (in January they went up to 6 dollars), and little baskets of mixed flowers such as one could buy for 2s. 6d. or 3s. in England were selling for 3 dollars.

The European allotment does not appear to exist in the States, though there are a few plots at Washington on some land reclaimed by dredging from the River Potomac that might be described as allotments. Washington, a City of 400,000 inhabitants, possesses fewer of these plots than would suffice a country village in England. One could not resist the reflection that if by some disaster, such as a widespread strike, the supplies were cut off, then Washington would be reduced to starvation in a few days, there being no cultivation of fruit or vegetables in or around it. The reasons why the allotment is not a feature of American life as here, were variously stated. The climate was given as one, the winter temperature being too low for ordinary outdoor vegetables and the summer too hot and dry for vegetable production without constant watering. The fact that the twilight is short was given as another reason. These may have had an unfortunate influence, but other factors also seem to have contributed to prevent a spread of the movement. The cheapness and low running cost of the automobile has made it possible for nearly everyone to possess a motor, and the evenings and Sundays are spent in the car, leaving but little time for other pursuits. This

may be a real reason why the villa gardens are but poorly attended and the allotments remain undeveloped.

Haste in cultivation of the commercial plantation is also evident. It is quite common to see large areas where cultivation is carried on amid standing stumps of the forest trees. These stumps stand 3 ft. to 4 ft. out of the ground, and are, of course, irregularly placed as Nature planted them. Any grower will realise what it means to carry on the processes of cultivation among such obstacles; yet many thousands of acres, particularly in Tennessee, Kentucky, Georgia and North and South Carolina are thus cultivated. These large areas, though cultivated by different people, are not divided by hedges, such as is the custom in this country and which makes the lanes of England so picturesque, but are generally left unfenced, except where cattle have to be kept in bounds, when various styles of rapid, inexpensive and generally untidy methods of fencing are resorted to. A unique method was that adopted by a large Dairy Company who constructed an ugly but effective fence by using the stumps of the trees that once covered the land and piling them up side by side. Idle land has no place in the American rotation, for one sees no fallows, unless the land where corn (maize) was gathered last year and is now left with the stalks still standing amid the weeds, can be regarded as a fallow. The practice of forcing wild flowers such as foxglove and cornflower may be due to this haste of exploitation—or perhaps to the policy of the Federal Horticultural Board which, by making the importation of the better types almost impossible, drives people to the common and makes possible fortunes from weeds. Other practices may perhaps be due more to circumstances than to any characteristics of the people. Town manure is very scarce, and the cost of carriage over long distances is prohibitive. This has led to the practice of growing green crops for ploughing in for "soil improvement" on a very much greater scale than in England. A favourite crop for this purpose is a mixture of tares and rye, though many other crops are used. A grower of outdoor cucumbers at Norfolk, Virginia, was using sorghum for this purpose. He said the sorghum when 10 ft. high would be ploughed by the aid of a specially constructed machine into the land.

It may be of interest to record this grower's method for manuring his cucumbers. The variety grown was a white spine, shorter than our greenhouse varieties. The plants were raised in heat in April and planted out in the beginning of May. The

land receives 100 loads of manure per acre, consisting mostly of town manure but containing a mixture of fine tobacco dust bought at 2 dollars a ton, which is put in to serve as an insecticide. Artificial manure containing 7 per cent. of ammonia, 6 per cent. of phosphate, and 5 per cent. of potash is added. The grower also had an ingenious method for supplying liquid manure to his cucumbers. Water was lifted by means of a pump geared to an old Ford car engine from 6 wells into one main from which it issued on to a piece of sacking stretched over a collecting tub. A negro workman, provided with a watch, was stationed by the tub to put 5 lb. of nitrate of soda on to the sacking at intervals of every 5 minutes, the pumps delivering 50 gallons of water every minute. The water containing the nitrate of soda was conveyed to the cucumbers by means of overhead pipes on the "Skinner" system. Such practices serve merely as examples to show the many methods to overcome difficulties in manuring employed by the American.

The climate naturally varies over so wide an area, and the effect is seen in the practices in operation in the different States. In Florida the season of vegetable culture is from November to May. Tomatoes are grown extensively out of doors: one man is said to cultivate 1,000 acres of this crop. They finish by the end of May when the land becomes ready for corn (maize). Here also grape fruit and other citrous fruits form an important crop. Mangoes are just being developed, by breeding, into a popular variety of fruit. Great thought is being given to the methods of transporting the mangoes. The latest device consists of a box divided into three compartments, the two end compartments being lined with the finest type of wood wool, in which the fruit is packed. The centre compartment, provided with holes on both sides of it, contains ice for cooling purposes. The Avocado, or Alligator Pear (although it is not a pear at all), is now being largely cultivated. The fruit is eaten as a vegetable with oil and condiments. Pineapples are grown in large quantities, coconut palms grow wild and ripen their fruit, and sweet potatoes and rice are cultivated.

The extreme variations in climate between summer and winter are experienced at Norfolk, Virginia, where outdoor cucumbers are grown in abundance in summer, but the winter is so cold that glass must be provided to protect the parsley crops.

The effect of these climatic conditions upon the growth of trees is remarkable. The oak grows much more rapidly there. In Washington the Kinko Biloba makes a handsome tree.

When one comes to the north—to Canada—apple trees may burst their bark and even their roots under the effect of severe frost, while vines ripen their fruit out of doors, peaches are grown extensively as half-standards, and maize set out in July ripens its seed before winter sets in.

* * * * * *

THE TWELFTH REPORT OF THE DEVELOPMENT COMMISSIONERS.

THE Report of the Development Commissioners for the year ending 31st March, 1922, which has recently been issued by H.M. Stationery Office,* contains an account of the greater part of the agricultural research carried on in the United Kingdom during the year. Owing principally to the general restriction in public expenditure the total advances from the Development Fund were less than for several years past, amounting to £368,450, compared with £636,467 in the previous year. Of the former amount £236,031 went to agriculture and rural industries, including reclamation and drainage of land, and the remainder to harbours and fisheries.

The benefits conferred on agriculturists by the Fund will be realised from the estimate of the Commissioners that the total expenditure of the United Kingdom on agricultural research during the year is unlikely to have exceeded £200,000, of which £172,000 was provided by the Development Fund. This State expenditure has, moreover, not merely taken the place of private expenditure, as the sum spent before the Development Fund was available was less than one-tenth of that of the present day.

Rural Industries.—The subjects to which the Commissioners have given special consideration during the year have been Rural Industries and Animal Diseases. It is pointed out in the report that rural industries flourish in France and Germany while they are derelict in this country. Yet England is not inferior to those countries in natural resources and industrial skill, while it provides a rich and wide market which indeed now absorbs large quantities of the products of foreign rural industries. Moreover, rural industries are the solution of the difficult problem of finding suitable employment for disabled ex-Service men, and it is noteworthy that in France and Germany this problem hardly exists.

The Commissioners therefore framed a scheme for setting up (a) the Rural Industries Intelligence Bureau, which will offer

* To be obtained through any bookseller, or direct from H.M. Stationery Office, Imperial House, Kingsway, London, W.C.2, price 3s. 6d. net.

skilled advice to those engaged in or contemplating the establishment of any rural industry, and (b) The Country Industries Co-operative Society, Ltd., for supplying materials and marketing the products.* The former was assisted by a grant of £2,500. The latter, being a trading association, is not aided financially. The Commissioners also made a grant of £4,210 to the Oxford Institute of Agricultural Economics for a detailed examination of existing rural industries in England and Wales. A full and interesting report by Mr. E. C. Kny on industries in rural districts is printed as Appendix II to the Report under notice.

Animal Diseases.—As regards diseases of animals it is pointed out that in human medicine great advances have been made in recent years and there has been an organised attempt to secure the benefits of new knowledge and methods; in veterinary medicine, on the other hand, the effort has been slight. Yet every farmer is aware of the annual losses which disease causes him, and the cost to the public has been forcibly demonstrated by the heavy bill of costs incurred in combating the outbreak of foot-and-mouth disease in the past year. The Commissioners accordingly appointed an Advisory Committee in 1921 to inquire into the subject, and a programme is now being prepared to give effect to the recommendations of the Committee. A substantial sum out of the funds allocated to the Development Commission under the Corn Production Acts (Repeal) Act, 1921, has provisionally been reserved to give effect to the scheme. The chapter on the subject contained in this report should be widely read in order that both agriculturists and the general public may support the Commissioners in putting an end to a state of affairs which the Report describes as a national disgrace.

Agricultural Research and Education.—The following grants to the Ministry of Agriculture and Fisheries were recommended by the Commissioners for the continuance of the agricultural research scheme and for the development of agricultural education.

Grants to institutions in aid of :—	£
(a) Scientific research and experiments (maintenance grants)	78,000
(b) Extension of advisory work	21,000
(c) Special investigations	4,000
Research scholarships and travelling research fellowships ..	2,000
Administration expenses	1,200
	£106,200
Less amount not payable from the Development Fund ...	1,150
	£105,050

* See this *Journal*, Vol. XXIX, pp. 348 and 549.

The following grants to the Ministry were also recommended:—

	£
Grant to meet the deficit on the working of the Cattle Testing Station during the year 1921-22	1,094
Agricultural machinery experiments: Year 1921-22	5,650
University College, Reading: Grant towards cost of stocking the farm in connection with the Research Institute in Dairying	2,500
Alterations and additions to the Ministry's vegetable drying and fruit preserving factory at Chipping Campden (additional factory grants)	1,250
Demonstration Lactose Factory*: Further capital expenditure and cost of maintenance up to 31st March, 1923	7,450
Cost of an inquiry into a Superannuation Scheme for certain agricultural institutions	250
Maintenance of a Willow Experimental Station: Year 1922-23	800
Maintenance of National Institute of Agricultural Botany: Year 1921-22	2,450
Ditto: Year 1922-23	3,000
Demonstrations in intensive milk production on arable land. Net expenditure during the year 1921-22	1,300
Ditto: Year 1922-23	2,300
Experiments in the cultivation and rehandling of tobacco: Capital expenditure and costs of experimental work during the four years from 1919-20 to 1922-23	2,000

Agricultural Machinery Experiments.—The grant of £5,650 was made to cover the salary and expenses of an engineer, experimental work on drainage machinery, potato diggers, tractor harvesting machinery, hedge-cutting machinery, turnip thinning and harvesting machinery, and minor experimental work. The results of this work are in course of publication in a series of reports,† and articles summarising the results are appearing in this *Journal*.‡

Milk Production on Arable Land.—The large scheme of demonstration holdings originally proposed has had to be cut down on account of the financial situation, but three holdings have been retained for the purpose of demonstrating the possibility of providing a large production of milk by arable cultivation, and securing information by experiments which farmers cannot risk making, as to the best rotations and systems of farming for the purpose.

Willow Experimental Station.—On the recommendation of an Advisory Committee appointed by the Ministry the Develop-

* See this *Journal*, Dec. 1922, p. 774.

† Hedge and Stump Clearing Devices; Misc. Pubn. No. 35, Ministry of Agriculture and Fisheries, 10, Whitehall Place, S.W.1, price 2s. 6d.

‡ This *Journal*, April, 1922, p. 6; July, 1922, p. 369; January, 1923, pp. 880 and 911.

ment Commissioners recommended a grant for investigations to be carried out in connection with the Long Ashton Agricultural and Horticultural Research Station, Bristol, with the object of extending the production of osiers, and providing advice for willow growers and basket makers on questions of organisation, marketing, and machinery, in order that foreign competition in the basket-making industry may be successfully faced.

An account is also given in the report of a number of investigations into special agricultural problems which were financed by the Commissioners. Work in Scotland and Ireland is also dealt with.

* * * * * *

SUB-SOILING.

PRELIMINARY REPORT OF A TRIAL OF SUB-SOILING DEVICES HELD AT HIGH HILDON, TONBRIDGE, IN OCTOBER, 1922.

Introductory.—In many soils there exists below the top soil a solid stratum which may vary in thickness from 4 in. to 10 in., formed either by chemical action or by the mechanical action of continuous cultivation, particularly ploughing, carried on year after year at the same depth. This hard "pan" has certain obviously bad effects. It does not allow of the free passage of water and air and generally impairs the fertility of the soil.

The practice of disturbing the hard pan, usually called sub-soiling, has been practised for at least a century, but the records of experiments which have been published clearly show that sufficient care was not exercised in determining exactly what the process was which produced favourable results, and why failure attended subsequent attempts to repeat these experiments. It appears, however, that some experimenters at least ploughed deep (*i.e.*, inverted the soil) when they believed themselves to be sub-soiling, and brought to the surface soil which required a long time to weather before it became fertile. But these distinctions were not at the time appreciated; and consequently sub-soiling was condemned when condemnation should probably have been found in deep ploughing unsuitable soil. From time to time, however, the practice has been revived and in some districts appears to have been followed continuously for a long period; but it is at present impossible, in the absence of carefully recorded experiments, to indicate the limits within which

sub-soiling is beneficial. The factors are many and an extensive scheme is required to determine all the underlying principles involved. It is not only a question of using a suitable machine in the right way, but also of determining what effect sub-soiling has upon the yield and quality of future crops. Some scientific experiments have already been carried out abroad but have not yielded much more than negative results, and the Ministry has decided therefore to institute investigations for the purpose of ascertaining the cost of sub-soiling and its results on various types of land.

Method of collecting Data.—Typical soils have been chosen in different parts of the country so that as many conditions as possible which may influence the results may be included, and the investigations will extend over a period of at least five years. The data will be collected under two heads:—

(1) The cost of performing the operation by various methods will be determined: mechanical data relating to the efficiency of the various machines will also be obtained.

(2) Data will be collected as to moisture content, soil temperature, chemical and mechanical changes, and the resultant yield and quality of the crops.

It will be at least a year before information will be available under the second heading, and so far, the data available relate only to the cost of sub-soiling by each method employed and the mechanical effect of each implement in disrupting and disturbing the hard "pan."

Test and Demonstration at High Hilden, Tonbridge.—It is proposed here to present the results of a test of seven sub-soiling devices organised by the Ministry, acting in conjunction with the Kent Agricultural Education Committee and the local Branch of the National Farmers' Union, and held at High Hilden, Tonbridge, in October, 1922, by the courtesy of Mr. F. O. Streeten. The field upon which the tests were held was stubble land with a gentle slope downwards from the south-western end, the soil being medium loam ranging from about 7 in. deep at the top end to 10 in. at the bottom, over a clay sub-soil. Plots of equal area were marked out and allotted to the various machines, and a control plot was provided for ploughing only.

Tests were made for the purpose of ascertaining as far as possible the economic and mechanical efficiency of the sub-soiling devices. On the first day a capacity and consumption test was made. Each device was run for a definite time and measurements were taken of the area ploughed and sub-soiled, the average dimensions of work done, and the consumption of

fuel. Records were taken by a Watson dynamometer of the pulls registered by each device when ploughing only and when both ploughing and sub-soiling. The difference between the two results shows the increase of load due to sub-soiling. One observer was allotted to each machine and from the records taken the final results have been compiled. Every precaution was taken to ensure accuracy The ploughmen were instructed to plough at a uniform depth of 7 in. and to sub-soil a further 5 in. and measurements were taken at regular intervals for each machine.

Observations on the Performance of each Device and Summary of Results.

(1) *Ransomes' Self-lift Tractor Plough (R.S.L.S., T.C.P.)* with solid coulter, skim coulter and sub-soil tine. Manufactured by Messrs. Ransomes, Sims & Jefferies, Ltd., Ipswich. Price £34 1s. 6d. Tractor: British Wallis, 25 H.P. Price £300.

Width of furrow in inches	10
Depth of ploughing in inches	7·5
Extra depth sub-soiled in inches	5·5
Drawbar load in lb. when ploughing	816
Drawbar load in lb. when ploughing and sub-soiling	1,391
Acreage ploughed and sub-soiled per day	1·3
Cost of ploughing and sub-soiling per acre	24s. 2½d.

The sub-soiling tine on this single-breasted plough is attached at the rear and works in the newly made furrow bottom immediately behind the breast. Facilities are provided for rapidly adjusting the depth at which the tine works. The draw bar load registered by the Watson dynamometer was not very steady when sub-soiling, but was very regular when ploughing only. The work done by this plough was very good, the furrows being very regular.

(2) *Ransomes' 2-Furrow Self-lift Tractor Plough (R.S.L.D.-X L.)* Kent breast with sub-soil tine. Price of plough £37 8s. 6d., sub-soil attachment £4 extra. Tractor: Weeks-Dungey. Price £350.

Width of furrow in inches	10·5
Depth of ploughing in inches	7·25
Extra depth of sub-soiling in inches	5
Drawbar load in lb. when ploughing	825
Drawbar load in lb. when ploughing and sub-soiling	1,133
Acreage ploughed and sub-soiled per day	1·73
Cost of ploughing and sub-soiling per acre	17s. 6¾d.

The sub-soiling tine with this plough is mounted in the position usually occupied by the front breast. This implement ploughed and sub-soiled a greater area than Ransomes' deep digger and also registered a lower average draught, and did excellent work.

(3) *Ruston and Hornsby's Single-Furrow Self-lift Deep Digger.*—Price of plough £31 10s., with sub-soil tine £33 5s. Manufactured by Messrs. Ruston & Hornsby, Ltd., Grantham. Tractor: British Wallis.

Width of furrow in inches	14
Depth of ploughing in inches	7·9
Extra depth of sub-soiling in inches	5
Drawbar load in lb. when ploughing	925
Drawbar load in lb. when ploughing and sub-soiling	1,125
Acreage ploughed and sub-soiled per day	2·75
Cost of ploughing and sub-soiling per acre	12s. 5¾d.

14

The sub-soiling tine on this plough follows immediately behind the breast and so sub-soils under the newly made furrow bottom. A very regular draught was registered. In the capacity test, a considerably larger area was ploughed than by any other machine, but it must be observed that good work was to some extent sacrificed for speed. This plough turned the largest furrow of any machine under test.

(4) *Ruston and Hornsby's 2-Furrow Self-lift General Purpose Plough.*—Price £35 10s. Tractor: British Wallis.

Width of furrow in inches	10
Depth of ploughing in inches	7·23
Extra depth of sub-soiling in inches	5·83
Drawbar load in lb. when ploughing	704
Drawbar load in lb. when ploughing and sub-soiling	1,160
Acreage ploughed and sub-soiled per day	2·07
Cost of ploughing and sub-soiling per acre	16s. 0½d.

The sub-soiling tine on this plough is fitted in place of the front breast and so runs under the furrow bottom made previously. With the exception of the Ruston and Hornsby deep digger, this plough covered a greater area than any other plough, though here again the work done was not quite of the same quality as that done by other ploughs at less speed. The draught of this plough was noticeably light, but the extra load due to sub-soiling increased the total draught considerably owing to the sub-soiling tine being set at a greater depth than any other.

(5) *Celliers Sub-soil Attachment.*—Manufactured by Celliers Motors Ltd., Brighton Road, Coulsdon, Surrey. Price £12 12s. Sellar's plough. Tractor: Fordson. Price £120.

Width of furrow in inches	10
Depth of ploughing in inches	7·4
Extra depth of sub-soiling in inches	5
Drawbar load in lb. when ploughing	1,003
Drawbar load in lb. when sub-soiling	453
Acreage ploughed and sub-soiled per day	1·68
Cost of ploughing and sub-soiling per acre	16s. 8d.

In this case the sub-soiling attachment does not form part of the plough, but is attached to the rear of the tractor, the sub-soiling tine being immediately behind the right hand driving wheel. A screw and handle is provided to regulate the depth of working, and it is necessary to raise the sub-soiling tine when travelling round headlands. This unit performed very good work, but it would be an advantage to have marked on the adjusting screws the tine depth in relation to the plough depth. Some ready means of raising the tine when travelling on the headlands should also be devised.

(6) *Darby Sub-soiling Conversion Set.*—Manufactured by S. C. Darby, Wickford, Essex. Attached to an International tractor plough. Price of attachment £7 15s. Tractor: International Junior. Price £250.

Width of furrow in inches	10
Depth of ploughing in inches	7·4
Extra depth of sub-soiling in inches	5·1
Drawbar load in lb. when ploughing	799
Drawbar load in lb. when ploughing and sub-soiling	1,200
Acreage ploughed and sub-soiled per day	1·28
Cost of ploughing and sub-soiling per acre	25s. 6d.

The Darby conversion set can be attached to any plough, but during tests it was used with an International tractor plough, the front breast being removed for this purpose.

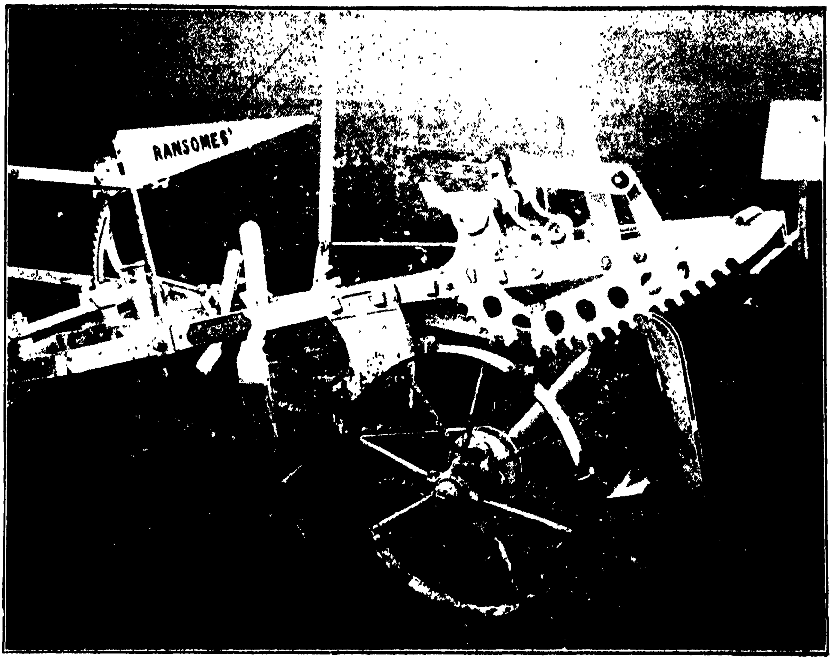

FIG. 1.—Ransomes' Tractor Plough and Sub-Soiler.

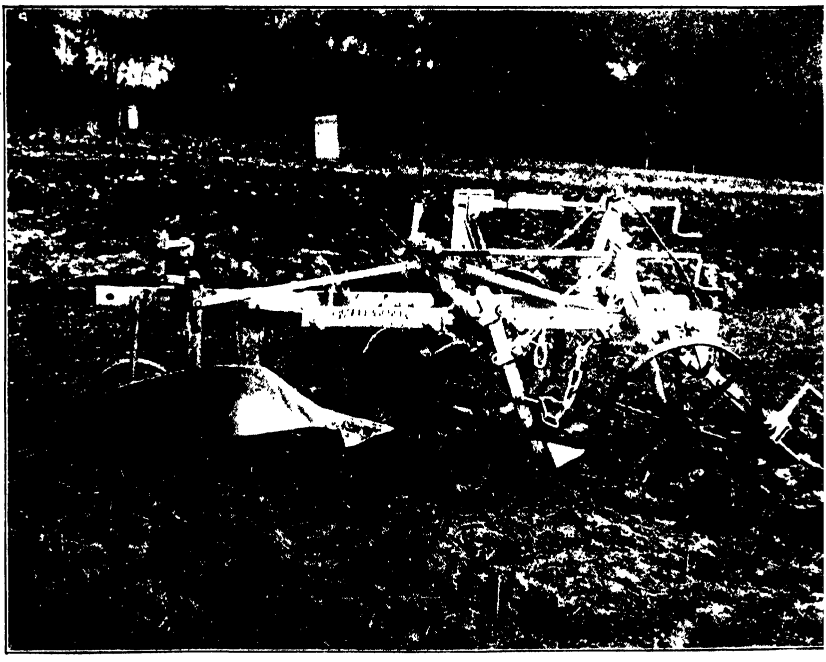

FIG. 2.—Ruston & Hornsby's Tractor Plough with Sub-Soiling attachment.

FIG. 3.—Celliers' Sub-Soiler for attachment to Tractor.

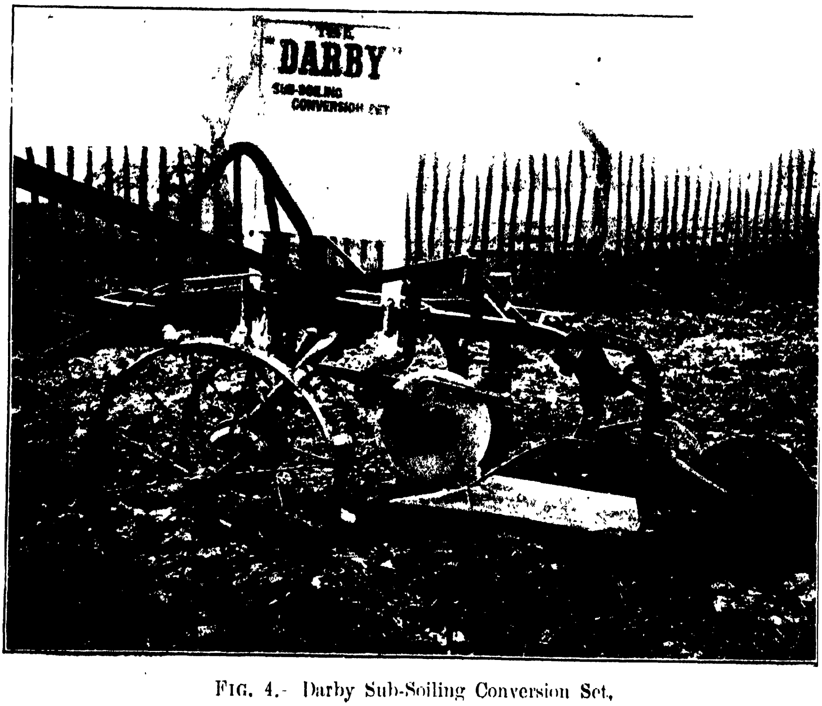

FIG. 4.- Darby Sub-Soiling Conversion Set.

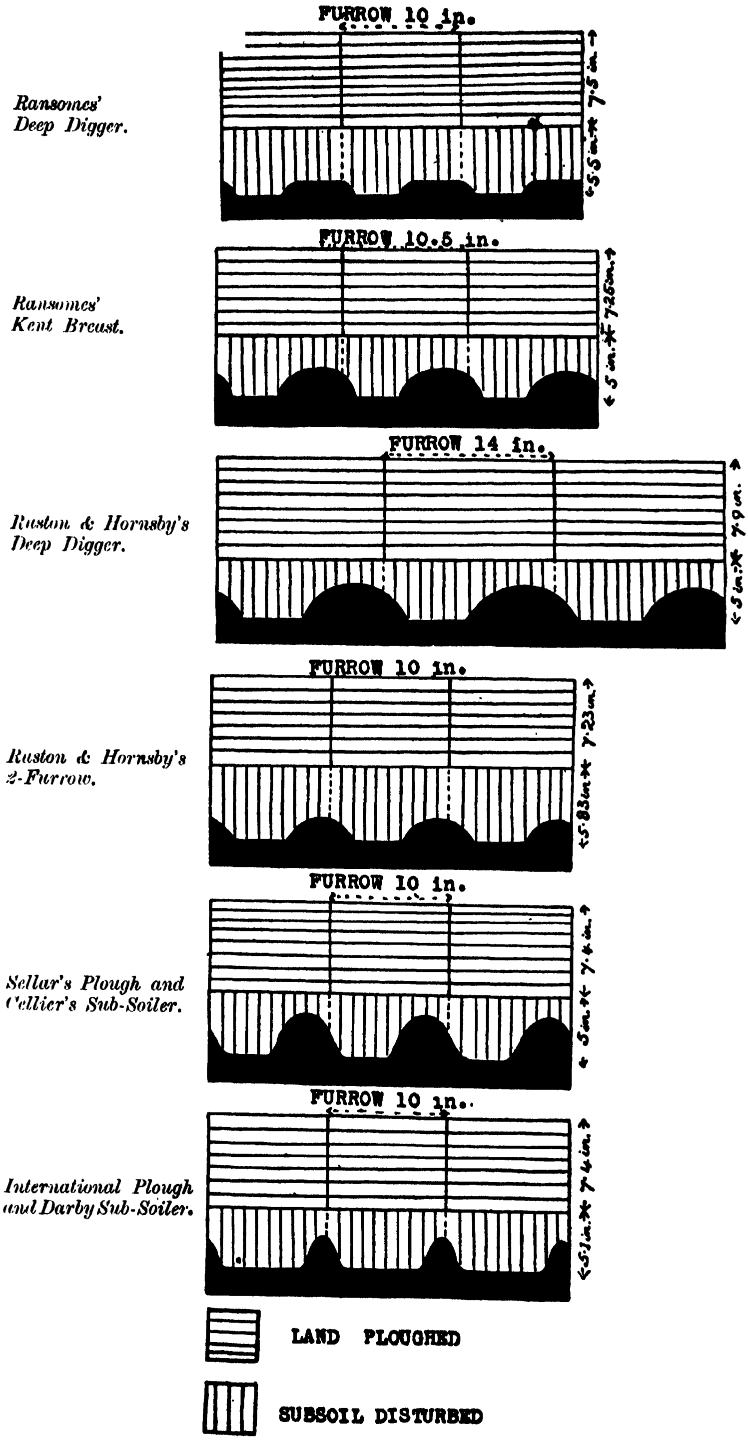

FIG. 5.—Sectional view of Land Ploughed and Sub-Soiled.

(7) *Ransomes' XL. Horse Plough, fitted with Sub-soil Attachment.*—Manufactured by Messrs. Ransomes, Sims & Jefferies, Ltd. Price £14 14s. complete.

Width of furrow in inches	9·5
Depth of ploughing in inches	6·9
Extra depth of sub-soiling in inches	5
Drawbar load in lb. when ploughing	490
Drawbar load in lb. when ploughing and sub-soiling	822
Acreage ploughed and sub-soiled per day	1·93
Cost of ploughing and sub-soiling per acre	25s. 3d.

Three horses were used to pull this sub-soiling plough. The tests were carried out in the early part of the day when the horses were fresh and the ploughmen urged them to do their utmost, and the acreage shown per day is considered to be in excess of the area that a team would do during an average working day. The quality of the work done was very high.

The control plot was ploughed by the Ruston and Hornsby 2-furrow plough at a depth of 7 inches.

Conclusion.—The figures in Table II relating to the quality and quantity of disruption are useful in showing weaknesses in the design of some of the machines. A low disruption of the soil, and a heavy drawbar load indicates that there is some radical modification needed in the design of the tine. For ideal tine action, quality and quantity of the disturbance of the sub-soil should be good and the drawbar load reasonably low.

Whether the sub-soil should be brought to the surface is a matter easily determined when working in clay, where the action is known to be harmful, but in some soils it would be a matter of conjecture and could only be determined by experiment. It may therefore be necessary to employ differently shaped tines for different soils. At Tonbridge the sub-soiling devices were required to disturb the pan without actually inverting it and each machine satisfied this condition. With the exception of the Darby, which is in the form of a straight breast, every sub-soil attachment resembled a cultivator tine in shape.

After the land had been ploughed and sub-soiled, portions of the soil were cut away in each plot in order to ascertain the effect. It was discovered that the sub-soiling tine does not disturb a width equal to the width of the furrow slice. The sub-soil, when regarded in section, presented a series of small ridges, the dimensions of which varied for each machine. In places the Darby sub-soiling tine cuts an almost circular drain, resembling that made by a mole plough. It was decided to observe the effect of deep sub-soiling, and for this purpose Ransomes' deep digger plough was used, ploughing 8 in. deep

TABLE I.

ESTIMATED RESULTS FOR A WORKING DAY OF EIGHT HOURS.

Soil: Medium Loam 7—10 in. with clay sub-soil. Climatic conditions: Dry and Cold.

Plough and Sub-soiling attachment	Power	Average dimensions of work done.			Average speed of ploughing and sub-soiling in miles per hour	Total acreage ploughed and sub-soiled	Average speed during dynamometer tests in miles per hour	Average drawbar loads registered				Estimated Cost per acre (including capital charges)	
		Ploughing		Sub-soiling				Ploughing		Ploughing and Sub-soiling			
		Width	Depth	Depth				Reading 1	Reading 2	Reading 1	Reading 2		
		In.	In.	In.				lbs.	lb.	lb.	lb.	s.	d.
Ransomes' Deep Digger	British Wallis Tractor	10	7·5	5·5	1·61	1·3	2·21	771	862	1,424	1,358	24	2½
Ransomes' Kent Breast	Weeks-Dungey Tractor	10·5	7·25	5	2·04	1·73	1·47	819	831	1,130	1,135	17	6¾
Ruston & Hornsby's Deep Digger	British Wallis Tractor	14	7·9	5	2·43	2·75	1·10	943	907	1,102	1,128	12	5¼
Ruston & Hornsby's 2-furrow.	British Wallis Tractor	10	7·23	5·83	2·56	2·07	1·87	683	725	1,144	1,176	16	0½
Sellar's Plough, Celliers' Sub-soiler	Fordson Tractor	10	7·4	5	2·19	1·68	1·36	1,023	983	* 453	* 453	16	8
International Plough, Darby sub-soiler	International Junior Tractor	10	7·4	5·1	1·58	1·28	1·79	854	744	1,279	960	25	6
Ransomes' Horse Plough	3 horses	9·5	6·9	5	2·53	1·93	1·10	468	512	849	795	25	3

* Pull due to sub-soiling alone.

TABLE II.

INCREASED LOADS DUE TO SUB-SOILING AND PERCENTAGE DISRUPTION OF SUB-SOIL.

Plough and sub-soil attachment	Power	Average speed during dynamometer test	Average traction loads			Average loads per sq. in. cross section of furrow			Weight per c. ft. of material		Estimated percentage of effective disruption of pan below ploughed section
			Ploughing	Ploughing and sub-soiling	Per cent. increase in load due to sub-soiling	Ploughing	Ploughing and sub-soiling	Sub-soiling	Before ploughing and sub-soiling.	After ploughing and sub-soiling less amount not disturbed	
		Miles per hour	lb.	lb.		lb.	lb.	lb.	lb.	lb.	
Ransomes' Deep Digger	British Wallis Tractor	2·21	816	1,391	70·5	10·88	11·27	11·88	107	99·5	88
Ransomes' Kent Breast	Weeks-Dungey Tractor	1·47	825	1,133	37·3	10·84	9·77	8·1	107	95	76
Ruston and Hornsby's Deep Digger	British Wallis Tractor	1·10	925	1,125	21·6	8·36	7·17	4·33	107	90	66
Ruston and Hornsby's 2-furrow	British Wallis Tractor	1·87	704	1,160	65·1	9·74	9·52	9·2	107	99	85
Sellar's Plough, Celliers' sub-soiler	Fordson Tractor	1·86	1,003	* 453	—	13·55	—	13·5	107	90	67
International Plough, Darby sub-soiler	International Junior Tractor	1·79	799	1,200	50·2	10·8	10·18	9·14	107	100·5	86
Ransomes' Horse Plough	3 Horses	1·10	490	822	67·8	7·48	—	—	107	85	—

* Pull due to sub-soiling alone.

and sub-soiling a further 10 in. It was discovered that when working at this depth, the tine formed a drain resembling that made by the Darby, though the width of the tine standard caused a greater gap for the whole depth of the sub-soil. The sub-soil all round was well disturbed.

The tests at Tonbridge proved conclusively that the sub-soiling devices actually broke up the hard pan and disturbed the sub-soil without bringing any to the surface. Whether the correct type of sub-soiling tine has been evolved it is too early yet to say. The strakes on tractor wheels running in the furrow, assisted materially in breaking the hard pan and so decreased the load necessary to pull the sub-soiling tine.

Explanatory Notes to Tables.

Table I.—Results for a working day of eight hours.—Approximately one hour was allotted to each machine for its capacity test, but as only a fraction of an acre was ploughed and sub-soiled during the test the working time has been expanded so as to represent eight hours, and the results calculated accordingly for convenient comparison.

Average dimensions of work done.—The dimensions of work done were ascertained at intervals of 10 yards for all machines.

Average Speeds.—The dynamometer test was distinct from the capacity test, and the pulls recorded are those obtained during the dynamometer tests only. As a great divergence of speed occurred, the drawbar pulls are not strictly comparative, and it is probable that if records had been taken of the Ransomes' Deep Digger and the Ruston and Hornsby Deep Digger for instance when ploughing and sub-soiling, at the same speed, the results might have been appreciably different.

Average drawbar loads registered.—The drawbar loads were registered by means of a Watson dynamometer for tractor-drawn ploughs, and by a Salter dynamometer for the horse plough. The speed at which these results were obtained must be kept in view when studying the figures. The Celliers sub-soiling attachment was fitted to the tractor and not to the plough. A British Wallis tractor was therefore used to pull the Fordson both with and without the sub-soiling attachment in operation. The difference of pull recorded in this manner represents the pull due to sub-soiling alone, under the conditions of the test.

Estimated costs.—The actual fuel consumed by the tractors during the capacity tests was measured and the cost calculated, and to this main cost has been added the cost of labour and capital charges. Several types of tractors were used to draw the ploughs, and varied in price from £120 for the Fordson to £350 for the Weeks-Dungey. The capital charges for the latter tractor are therefore almost treble the former. This naturally increased the working costs of the ploughs drawn by the more expensive tractors, though the capital charges in themselves were not very large. A further point must be remembered, namely, that different types of tractors consume different quantities of fuel for similar work. The costs given apply only to each machine working under the conditions stated and drawn by the tractor named, and to this extent they cannot be regarded as strictly comparative.

Table II.—Increased loads due to sub-soiling and percentage disruption of sub-soils.—The first four columns do not require any explanation.

Average Loads per square inch cross section of Furrow.—From the diagrams, Fig. 5, it will be seen that the sectional area of sub-soil disturbed varied for each device. The average loads per square inch section have been calculated from the dimensions of work done and the pull absorbed at a definite speed.

Disruption of Sub-soil.—The volume of sub-soil disturbed by a sub-soiling tine depends upon the nature of sub-soil, the formation of sub-soil tine, and its speed of travel.

The degree of disintegration of sub-soil did not vary greatly for each device, the net result being that after ploughing and sub-soiling, the furrow slice was inverted and had the normal air space underneath, but beneath the usual furrow bottom was a volume of loose sub-soil containing air and permitting the roots of plants to enter.

To obtain information about the actual effect of sub-soiling, a cubic foot of earth was weighed before and after being ploughed and sub-soiled. The difference between these two weights under given conditions is a measure of the disintegration that takes place.

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COUNCIL OF AGRICULTURE FOR ENGLAND.

THE Ninth Meeting of the Council of Agriculture for England was held on 7th December, 1922, at the Middlesex Guildhall, Westminster. The Chair was taken by Sir Douglas Newton, K.B.E., M.P.

Appointments to the Agricultural Advisory Committee for England and Wales.—At separate meetings of Minister's Members, and County and Borough Agricultural Committees' Members held previously to the full Council Meeting, the following Members of the Agricultural Advisory Committee, retiring under Regulation 8, of the Agricultural Councils and Advisory Committee Regulations, 1920, were reappointed for a further period of four years:—

Minister's Members.—Lord Clinton, representing owners of agricultural land; Mr. George Edwards, representing agricultural workers; Lady Mabel Smith, representing women.

County and Borough Agricultural Committee's Members.—The Right Hon. Lord Ailwyn of Honingham, Mr. E. W. Langford, and Mr. G. G. Rea.

Statement by the Minister.—The Minister of Agriculture made a statement dealing with certain matters of importance arising at the present time. He informed the Council of the position in regard to the Importation of Animals Bill now before Parliament, embodying the agreement which had been come to between the Home Government, in the time of his predecessor, and the Dominion of Canada. The conditions placed on the importation of animals under the Bill were the minimum safeguards necessary to protect the live stock of this country. The Bill was being taken in a very short time

at the urgent request of the Canadian Government, who wished to see the matter settled at the earliest possible moment.

The Minister also informed the Council that he proposed to set up a Departmental Committee to deal with the question of the disparity between wholesale and retail prices of agricultural commodities. The full terms of reference to this Committee were to inquire into the methods and costs of selling and distributing agricultural, horticultural, and dairy produce in Great Britain, and to consider whether, and if so by what means, the disparity between the price received by the producer and that paid by the consumer can be diminished. Complaints on this subject had been very manifest to anyone engaged in the recent General Election. He was hopeful that he would be able to announce the names of the Members of the Committee in the course of a few days.

The question of the extension of credit facilities to those engaged in agriculture was one which was already being carefully examined by a Cabinet Committee under Sir Theodore Chambers. A Report would probably be issued by it before Christmas, and he trusted that some practical Scheme which would give real assistance to the farmers in need might be evolved.

With regard to the incidence of rates in agricultural districts, the Minister stated that the subject had already been before the new Government, and that he was authorised to say that every effort was being made to find a satisfactory and early solution of the problem, and that it was hoped to make proposals when Parliament met again in the New Year.

On the question of the drainage of agricultural land, this was being dealt with in connection with unemployment relief, and was one of the most useful directions in which the work of unemployed persons could be utilised. A considerable amount of money had been expended last winter on relief drainage works. This year the Government had decided to allocate some £450,000 for the purpose, and the work under this scheme was to be completed by the 31st May next. Already over 200 schemes had been sanctioned and a large number of them were already in operation.

At the last Meeting of the Council the extensive outbreak of Foot-and-Mouth Disease which commenced last January was still raging. The Minister was happy to say that by the 30th June the outbreak had been brought to its last reported

case, and the country was declared free from disease following upon that outbreak about a month ago. Further cases had, however, occurred recently in other parts of England, though the new outbreak was not serious. He hoped that with the measures now being taken to control the spread of the disease, the Ministry would soon be able to declare the country once more free of it. The Departmental Committee, under the Chairmanship of Capt. Pretyman, M.P., which was inquiring into the origin and circumstances of the recent large outbreak of Foot-and-Mouth Disease, and into the policy and procedure that were followed in dealing with outbreaks at the present time, were holding their final meeting that day and he hoped that Report would be presented very shortly.

The grant in aid of agricultural development made under the Corn Production Acts (Repeal) Act, 1921 (the share of which for England and Wales amounted to £850,000), was being allocated in accordance with the agreement which had been reached that the sum should be expended during the period of five years ending 31st March, 1927, and should be additional to the sums which were formerly being spent by the Government on agricultural education and research. Some of the new schemes started out of the money would involve a continuing charge for maintenance after 1927, though it would be the duty of the Ministry to reduce such continuing charges to an absolute minimum.

In reply to questions, the Minister stated that the advisability of a test against abortion in the case of cattle imported for breeding purposes would be considered by the Ministry in framing any Order permitting such cattle to be imported. Representation for labour would be provided on the proposed Committee on Prices, and the Minister would consider whether it was possible to extend the terms of reference of the Committee to cover the question of the importation of flour. It was also stated that a Bill would be introduced before long to assist in the reduction of Sheep Scab on the lines indicated in the Report now being laid before the Council of the Proceedings of the Agricultural Advisory Committee.

Lord Selborne moved and Mr. A. W. Ashby seconded a motion that a hearty vote of thanks be accorded to the Minister of Agriculture for his statement. In the course of his speech Lord Selborne said that the Minister had entered on his great post at a moment of consummate tragedy in the history of the English countryside—far more, in his judgment, than that

of 40 years ago. He referred to the impoverished condition of landowners, and the outstanding facts of recent agricultural history. He thought the present position was due in some measure to the selfishness and ignorance of the urban population. Mr. A. W. Ashby, in seconding the vote of thanks, said that he regretted this statement by Lord Selborne, and gave his reasons.

Grading and Packing Apples.—Mr. R. R. Robbins, in the absence of Mr. H. German, moved the following resolution:—

"That the Ministry of Agriculture be requested to arrange, with the assistance of the Development Commissioners, for the establishment of a 'Packing Station,' working on co-operative principles, for the grading and packing of apples, to commence work next season. The Station should be fully equipped with the latest proved machinery and fittings for the purpose."

In doing so, he stated that, had he not been asked to move the resolution, he would have suggested that it was wiser to defer consideration of it until the subject had been fully considered by the organisations. Mr. R. C. Grey seconded the motion, provided that it carried with it the suggestion that the question should be deferred. The Rt. Hon. F. D. Acland put the definite proposition to the Meeting that the motion should be postponed, his reason being that it was part of a much larger question which could usefully come before the Council later on when the time was ripe for the Government to assist, not in the direct financing of such schemes, but in the financing of the organisation and development of co-operative societies for the sale of produce. Mr. H. Padwick seconded this proposal, and the question was postponed, by leave of the Council.

Prices of Wheat, Flour and Bread.—Lord Bledisloe intimated that in view of the statement by the Minister he proposed, with the leave of the Council, to withdraw his proposed motion:—

"That the Council be informed whether any, and if any, what steps are being taken by His Majesty's Government to ensure that there be some direct relation between current prices of wheat, flour, milling offals and bread."

Land Settlement.—In the absence of Mr. Denton Woodhead, Mr. Dallas moved:—

"That this Council recommends the Minister of Agriculture at once to institute careful enquiries into the progress which is being made by ex-Service men who have been installed on the land under the Land Settlement Act, 1916."

Mr. George Nicholls seconded the motion, stating that unless something were done very quickly to reduce the rents of many of the ex-Service men and to assist them with credit facilities,

their position would be one of very great difficulty. He added that the question was one which should be thoroughly thrashed out by the Council, and he would like to see inquiry made and the Council furnished with particulars of the results. The motion was put to the meeting and carried.

Local Taxation and Rates on Agricultural Land.—Mr. James Hamilton proposed, in view of the statement made by the Minister, to withdraw the motion standing in his name:—

"That this Council respectfully urges the Government that, at the earliest possible date, the whole incidence of local taxation as affecting agricultural land be revised; that rates on agricultural land be only levied in proportion to the benefit which it derives from the services provided thereby; and that a larger contribution be made from National Funds towards local rates in respect of National Services and especially with regard to main roads."

His proposal was seconded, and, by leave of the Council, the motion was withdrawn.

Grant to Heavy Horse Societies.—Mr. Colin Campbell moved:—

"That this Council regrets the action of the Ministry of Agriculture and Fisheries in withdrawing the grant to Heavy Horse Societies. Further, in view of the fact that the small amount of money expended conferred great benefit on the production of heavy horses, it strongly urges the Ministry to restore the grant for the 1923 season."

Mr. Campbell added that it was only about £3,000 that was required. Mr. Griffin seconded the resolution, and hoped that the Ministry would not only renew the grant but give a larger sum. The position was discussed at length by the Council and in the course of it, Sir Daniel Hall stated that the Ministry had been compelled to withdraw the grant on the grounds of economy. It was a recommendation of the Committee on National Expenditure that the Live Stock Improvement Schemes should be cut down to the extent of two-thirds. It was the fact that the other Improvement of Live Stock Schemes, such as Milk Recording and the Use of Better Bulls were considered relatively of greater importance than the Heavy Horse Societies' Scheme. A considerable number of these Societies had been established and had proved very successful in their working. The Societies were, generally speaking, now standing on their own legs and doing very good work. After all, the Scheme was primarily an educational one and did not have the object of providing better sires permanently. The circumstances had also been largely altered by the passing of the Horse Breeding Act of 1918, removing unsound stallions. The motion was, later, put to the Meeting and carried.

Credit Facilities.—Mrs. Hugh Middleton moved the following resolution:—

"That this Council respectfully requests His Majesty's Government to provide means by which farmers who have bought their farms and are short of capital can borrow money at a low rate of interest, to enable them, when necessary, to improve their buildings and drain their land."

The mover considered that the passing of such a resolution by the Council ought to strengthen the hands of the Government. Immediate action was necessary if hard cases were to be dealt with before they became disasters. State funds should replace mortgages at the lowest possible commercial rate of interest. Mr. G. G. Rea seconded the motion. Mr. Clement Smith proposed that the words "drain their" should be omitted from the last line of the resolution. This motion was seconded, but on the suggestion of Lt.-Col. Courthope, M.P., the mover and seconder of the original resolution and of the amendment, agreed to a resolution running as follows:—

"That this Council respectfully requests His Majesty's Government to provide means by which farmers can borrow money at a low rate of interest."

This amended motion was put to the Meeting and carried.

Report of the Agricultural Advisory Committee.—Mr. G. G. Rea moved that the Half-Yearly Report (No. 4) to the Councils of Agriculture for England and Wales of the Proceedings of the Agricultural Advisory Committee be received by the Council. Lord Bledisloe drew attention to paragraph 6 of the Report, in which the statement was made that the Agricultural Advisory Committee did not consider that the provision requiring the Ministry to give consent in each case before Local Authorities took legal proceedings under the Fertilisers and Feeding Stuffs Act, 1906, should be abolished. He said that he did not agree with that recommendation and thought the requirement should be abolished. He hoped the Council would support his view.

The Council decided that the Half-Yearly Report should be received, subject to the attention of the Agricultural Advisory Committee being drawn to the matter referred to by Lord Bledisloe with a view to further consideration being given to it.

* * * * * *

AGRICULTURAL ADVISORY COMMITTEE FOR ENGLAND AND WALES.

THE following is the half-yearly report (No. 4) to the Councils of Agriculture for England and Wales, on the proceedings of the Agricultural Advisory Committee:—

The Agricultural Advisory Committee has had five meetings since the 18th May last, when the last half-yearly report was presented.* The subjects to which the Committee gave the attention which is outlined in this report were as follows:—

(1) **The Milk and Dairies Bill.**—The proposed provisions of this Bill, which had been promoted by the Ministry of Health, were submitted at an early stage for consideration by the Committee. The Committee concurred generally in the objects of the Bill, but considered that the proposals for dealing with tuberculosis of the udder were unsatisfactory and would be better omitted unless they could be made fully practicable and compensation provided as under the Tuberculosis Order in respect of cows eliminated from dairy herds on account of tuberculosis of the udder. They did not approve, also, of a proposed clause in regard to branding of animals so affected. The Minister undertook to bring their advice before the Minister of Health.

(2) **The Grant of £850,000 for Agricultural Education and Research.**—It was pointed out that in accordance with the understanding which had been agreed upon with the Committee, the further allocation of money for Farm Institutes was to be suspended pending a decision as to the proposed Grant for Research into Animal Diseases. The Ministry was being pressed to sanction progress with certain Farm Institute Schemes, and it was suggested that the Committee should now agree to vary the understanding so as to allow the Ministry to proceed with such Schemes where it was necessary to do so in order to relieve local trouble and irritation. This was agreed to on the further understanding that the spirit of the undertaking would continue to be observed. With regard to the Grant for Animal Disease Research, the Minister's suggestion that the Research Institute should be proceeded with at Cambridge University was approved.

(3) **Wart Disease Policy.**—As reported in Half-Yearly Report No. 3, the Potato Advisory Committee had recommended that the "1921 Policy," as opposed to a revised Policy which had been suggested by the Ministry with a view to financial economy, should be put into operation. The position was discussed by the Committee, and it was agreed that the Ministry should endeavour to carry out the "1921 Policy" with the smaller staff then available, the National Farmers' Union and other agricultural bodies being asked to do their utmost to assist the Ministry in the matter.

(4) **Sheep Scab Policy.**—The Committee considered the proposition which was made by the Ministry that an Order should be issued requiring after an interval of say 2 years that any owner having sheep, or selling sheep, affected with Scab should be liable to a heavy penalty unless he were able to

* See this *Journal*, June, 1922, p. 257.

show that he habitually took proper measures to cure, and to prevent the occurrence, or recurrence, of the disease. The Committee agreed with the proposals and considered that it was of importance that agricultural Unions and Societies should be asked to bring the proposed change to the notice of farmers, and that the Ministry's pamphlets dealing with the best means of eradicating Sheep Scab should be widely circulated. It was agreed that the date upon which the Order might become operative should be 1st May, 1924, and that the penalties might properly be a minimum of £5, with a maximum of £100. The Committee also considered that a Single-dipping Order for the whole country might be issued so as to encourage the universal dipping of sheep, in addition to the requirement of double-dipping (within a specified short period) in those cases where Sheep Scab was found to exist.

(5) **Seeds Regulations.**—Certain detailed amendments of the Seeds Regulations, 1921, were considered and approved. It was agreed that cereal seeds should for the present and pending further experience of the provisions continue to be scheduled under the Regulations.

(6) **Proposed Amendments of the Fertilisers and Feeding Stuffs Act, 1906.**—The Committee agreed to proposals which were submitted to them to the effect that the Ministry should have power, as in the case of the Seeds Act, to make Regulations of control rather than to have hard and fast provisions laid down in the Act itself. It did not consider that the provision requiring that the Ministry should give their consent before Local Authorities took legal proceedings under the Act should be abolished in any amendment of the Law. The doubtful value of some fertilisers which were sold as "mixtures" was commented upon and the Committee considered that it was necessary to take steps to safeguard the farmer in this respect.

(7) **Store Cattle from Canada.**—In view of the fact that Parliament had declared its opinion in favour of the importation of store cattle from Canada, the question of the precise nature of the precautions against the introduction of disease, etc., which should be adopted was referred to the Committee by the Minister at their Meeting on 2nd August. This question was considered as well as the position in regard to breeding stock from Canada. It was agreed that the period of detention and supervision would require to be a good deal longer in the latter case than in the former if breeding stock were also proposed to be admitted. The whole position was carefully gone into and various necessary safeguards indicated. It was understood that no store animals could be admitted until an Amending Act had passed through Parliament. It was agreed that drafts of any proposed Regulations under the Act when passed, should be submitted to the Committee for consideration before issue.

At a later Meeting on 1st November, 1922, the terms of the agreement which had been reached in Conference between representatives of the Home and the Canadian Governments as to the admission of Canadian cattle, were communicated to the Committee. The Committee agreed that all precautions possible appeared to have been taken to prevent disastrous results accruing to the cattle of this country. The terms of the agreement were afterwards published.*

* See this *Journal*, December, 1922, p. 770.

(8) **The Agricultural Situation.**—At the Meeting on 5th October, the Minister invited the observations of the Members of the Committee as to any suggested steps which the Government might take to alleviate the agricultural situation. He had himself considered it closely. The position in regard to a Scheme of Agricultural Credit, the Reform of Agricultural Rating, the differences between the Wholesale and Retail prices, importation of flour, the possible production of cheap nitrogenous fertiliser, railway rates on agricultural produce and other matters were discussed.

(9) **Irish Store Cattle Trade.**—At the Meeting on 5th October, the Minister informed the Committee that he was prepared to issue an Order reducing the period of observation under licence after sale from 13 to 6 days in the case of Irish store cattle coming into Scotland, and allowing sales to take place at all markets in Scotland instead of only at the limited number which had been indicated. The Committee concurred in the issue of the Order.

(10) **The Outbreak of Foot-and-Mouth Disease.**—The Committee was informed of the circumstances of the outbreak which commenced at Harmondsworth in Middlesex on the 20th October. This outbreak had occurred at the time of the Dairy Show and had entailed special precautionary restrictions in regard to animals at the Show. Other outbreaks had taken place at Woodstock in Oxfordshire, Walton-on-Thames, Windlesham and Staines. The Committee agreed that it was a fortunate circumstance in the case of this outbreak that no market had become infected and the disease was apparently being kept well in hand.

(11) **Reports on the Proceedings of the Various Advisory and Departmental Committees set up by the Ministry.**—Two quarterly reports were received by the Agricultural Advisory Committee, outlining the work done by the other Committees of the Ministry. The recommendation of the Warble Fly Committee that animals affected with Warbles should be treated with a dressing of tobacco and lime was specially referred to, and it was stated on behalf of the Ministry that the dressing had definitely been found to give the highest percentage of success in killing Warbles. On the Machinery Advisory Committee's Report the question was raised as to the requirement of the Ministry of Transport that breaks and bands on the front wheels should be fixed on tractors used for cultivation when they travelled along a road. It was arranged that the representatives of the Ministry of Agriculture should assist the National Farmers' Union in their representations to the Ministry of Transport in the matter.

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THE "MOSAIC" DISEASE OF THE HOP.

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Introductory.—For several years past an obscure disease has been showing itself in hop-gardens in this country. The diseased plant resembles in some features, *e.g.*, the shortened, non-climbing stems (" bines "), a hop attacked by the so-called " nettlehead " or " eelworm " disease, known to hop-growers

for more than a quarter of a century—and it is probable that hop-growers generally have not yet distinguished between the two diseases. Mr. C. A. W. Duffield, in his investigations into the "nettlehead" disease, first clearly pointed out the difference between the two diseases. In neither disease, it may be noted here, was Mr. Duffield able to find evidence that an eelworm is the cause.

The present article deals only with one of the diseases, which observations have shown to belong to the "mosaic" or "virus" group of plant diseases. The other disease, viz., "nettlehead," which also probably belongs to the same group, is neither so deadly in its effect nor so contagious.

Description of the Disease.—The disease is usually first noticed by the hop-grower when the plant has probably been infected for some time. In this condition (see Fig. 1-3*) the stems ("bines") have shortened joints, are unable to climb the string or pole and have a limited growth of from 4 to 6 ft. from the ground; the leaves are more or less curled, with *recurved* margins,† are more or less mottled green and yellow, and together with the upper part of the stem are noticeably brittle. All the affected bines with arrested growth remain barren. In this condition the "hill" of hops is doomed; the diseased shoots may either remain green through the season or they may die off during the summer; the roots when examined are found to be partly dead.

Less frequently—perhaps in those cases where the infection is recent—the bine reaches to the top of the string or pole and produces a varying amount of "hops," but the presence of the disease is shown, on careful examination, by the fact that some of the leaves are curled and mottled, particularly on the lateral branches, and that some of the hop-cones show curious and characteristic malformations. In the commercial hop-garden it is most probable, however, that those hills whose bines reach the top and produce "hops" are *not* recognised by the farmer as being diseased, with the result that the disease is spread by cuttings taken from such hills.

In rare cases of the "mosaic" disease, the tips of the "bines" and also of the lateral branches, die back a certain distance.

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* The writer is indebted to Dr. Wormald for the photograph reproduced in Fig. 3.

† In the "nettlehead" disease, as Prof. J. Percival pointed out in 1895 (*Jour. S.E. Agric. College*, Vol. I, 1895, p. 5), the leaves show an *incurved* margin.

FIG. 1.—Showing five "Bines" of a Hop Plant severely attacked by "Mosaic Disease."

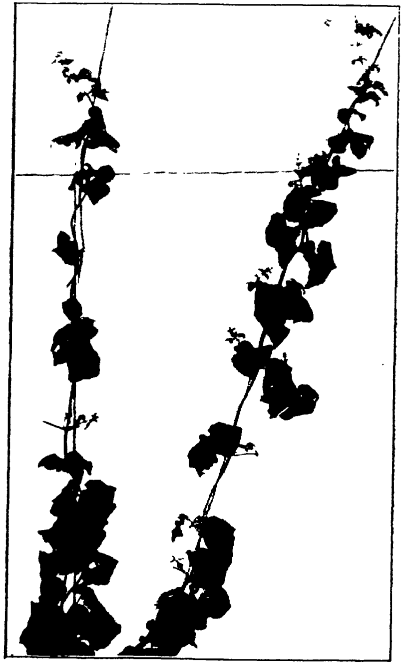

FIG. 2. Upper portion of the Plant shown in Fig. 1. The non-climbing tips of the "Bines," and the recurved leaves can be seen.

Photo] [Dr. H. Wormald.

FIG. 3.—Upper portion of the Stem of a Hop-Plant affected with the "Mosaic Disease": showing the dead tip and the curled leaves.

Nature of the Disease and its Spread.—The general appearance of the disease, and particularly the presence of "mosaic" (mottled green and yellow) areas in the leaves, suggest that the disease belongs to the group known as "mosaic" or "virus" diseases, of which the best known examples in this country are the "mosaic" disease of the potato and tomato, and the "leaf-curl" of the potato.* Prof. V. H. Blackman and his assistant, Miss Lacey, are at present engaged in carrying out investigations to ascertain, if possible, the cause of "mosaic" disease in the hop.

The object of this article is to draw the attention of the hop-grower to this apparently new disease, and to give evidence, collected in the hop-garden, which shows that *the disease is spread by means of cuttings taken from affected plants at a time when these are still apparently healthy.* The disease has been under observation for several years past both at Wye and at the East Malling Research Station. Some of the most striking cases showing how the disease can remain latent and be carried in cuttings taken from apparently normal plants are given below:—

Case I.—The hop-plant (Ref. No. B20) planted at Wye some time previous to 1906 remained apparently healthy until 1919, when it succumbed to the "mosaic" disease. Before this date the stock had been increased at Wye by the taking of cuttings which were planted in various places in the experimental Hop-garden ("nursery"). The history of these cuttings is as follows:—

Cuttings from B20.

Ref. No. of cutting.	*Date when planted.*	*Showed "mosaic" disease.*
D19	1910	1921
B19	1911	1915
C20	1911	1921
BB7 (from D19)	1919	1921
AA42 (from D19)	1919	1922
AA44 (from D19)	1919	1922
BB15 (from C20)	1919	1920
BB18 (from C20)	1919	1922
BB20 (from C20)	1919	1920

It will be seen from the above, that notwithstanding the taking of cuttings from apparently healthy plants the entire stock of B 20 at Wye died out from the "mosaic" disease. In the case of seven out of the nine cuttings mentioned, the neighbouring hop plants growing on either side of the cutting were free from the "mosaic" disease, so that it must be concluded that the

* In the United States "mosaic" diseases attack a large number of cultivated and wild plants, and have been extensively studied. Dr. W. W. Stockberger, of the United States Department of Agriculture, has informed the writer that no "mosaic" disease of the hop in America is known to him or his colleagues.

cuttings were infected at the time they were taken from the parent plant—a view which is strengthened by the similar evidence given by cuttings of B20 which were grown at East Malling.

These cuttings were taken in 1913 and 1914 from the apparently healthy parent-plant of B20 and its cuttings at Wye and planted in the nursery at East Malling Research Station; they were then planted out the next season,—one rooted "set" to the "hill,"—in a row of 35 "hills." The progressive appearance of the "mosaic" disease is shown in the following Table :—

	Hills affected with "mosaic" disease.
1914	2
1915	1
1916	11
1917	3
1918	0
1919	13
1920	9
	39*

The row was then grubbed up.

A second row of 35 hills of B20, derived similarly from cuttings taken from apparently healthy plants growing at Wye, was planted at East Malling in 1917. The fate of these plants was as follows :—

	Hills affected with "mosaic" disease.
1918	0
1919	27

The row was then grubbed up.

It seems clear, from the behaviour of the plants in other rows of new varieties which were being tested alongside the rows of B20 at East Malling, that the "mosaic" disease was carried in the cuttings of B20 from Wye to East Malling, and that they did not in this case become infected from some source present at the latter place. With regard to the second row of B20 planted at East Malling, the row of hops on one side was a variety (*Ref. No. P. 13*) which has never shown a hill affected with "mosaic" disease; and the row on the other side, consisting of another variety (Ref. No. 38) and the horticultural variety "Golden Hop," lost only seven out of the 35 hills, from the "mosaic" disease.

Case 2.—A seedling (Ref. No. OC32) was planted out at Wye in 1912; it remained apparently healthy until 1920, the plant being recorded in the field-book in 1919 as "healthy"; in 1920 all the shoots produced were severely affected with the "mosaic" disease. Another seedling (Ref. No. OC33) was planted in 1912 next to OC32; this plant showed malformed cones in 1919, indicating, probably, the first appearance of the "mosaic" disease, and the hill was therefore grubbed up. Cuttings were taken from both OC32 and OC33 during the years these two plants were apparently healthy and planted out both at Wye and East Malling. The fate of these cuttings is very instructive.

* Including some re-planted hills.

At Wye their record has been as follows :—

Cuttings from OC32. Ref. No.	*Planted.*	*Affected with "mosaic" disease.*
OX1	1914	1918
OX2	1914	1921*
OX3	1914	1919†
OX4	1914	1921
I10	1915	1922
OA57 (from OX4)	1919	1920
OB7 (from OX2)	1919	1921
OB15 (from OX2)	1919	1922
		Still apparently healthy.
J49	1915	1922
OB1 (from OX4)	1919	1922
OB3 (from OX4)	1919	1922
OB8 (from OX2)	1919	1922

Cuttings from OC33. Ref. No.	*Planted.*	*Affected with "mosaic" disease.*
OX13	1914	1921‡
J29	1915	1922
184	1918	1922
205	1918	1922
W56 (from J29)	1921	1922
W39 (from J29)	1921	1922
		Still apparently healthy.
J32	1915	1922
44	1918	1922
126	1918	1922
W65 (from J32)	1921	1922

At East Malling, rows of OC32 and OC33, consisting of 35 hills each, were planted during 1918 and 1919; on either side of them were rows of other new seedlings (Ref. Nos. Y86, P43, L40, 458). The records of the rows OC32 and OC33 are as follows :—

OC32.	*Hills affected with "mosaic" disease.*
1919	1
1920	0
1921	29
This row was then grubbed up ...	30
OC33.	
1919	5
1920	0
1921	18
1922	25§
	48

During all this period not a single hill in the adjoining rows became affected with the disease. It can be safely concluded therefore that the very

* This plant was recorded in 1920 as "vigorous and very fruitful."
† " " " " " 1918 " "very vigorous and fruitful."
‡ Some of the "hops" were misshapen in 1920.
§ Including some re-planted hills.

severe outbreak of the "mosaic" disease in the rows of OC32 and OC33, resulting in the practical extermination of these rows, was due to the fact that the disease was carried in a dormant condition in the cuttings.

Case 3.—In 1911 a seedling (Ref. No. L5) was planted out at Wye. This plant remained vigorous and fruitful until 1917, when it succumbed to "mosaic" disease. Cuttings were taken from it while it was still apparently healthy, and planted out in widely separated places in the Experimental Hop-garden (Nursery) at Wye. The fate of these cuttings was as follows :—

Ref. No. of cutting.	*Date when planted.*	*Affected with "mosaic" disease.*
S69	1911	1915
3S0	1912	1914
CC16	1915	1921
CC17	1915	1921
OA18	1916	1917
OB50	1916	1922
OB59	1916	1920

None of the plants growing on either side of these cuttings of L5 were affected with the "mosaic" disease. Here again it appears clear that the spread of the disease was effected by cuttings taken from an apparently healthy plant. It is interesting to note that two of the cuttings succumbed to the disease 2 and 3 years respectively before the parent-plant showed the disease.

Numerous other cases have been met with, all giving evidence that the "mosaic" disease is carried in cuttings.

Experiments in Treating Diseased Hills.—Before discussing the best methods of control, some experiments in treating diseased hills may be mentioned here. During the season of 1922 the experiment was tried, at the East Malling Research Station by Mr. J. Amos and the writer, of "pulling" early in the season (June) the diseased shoots of "hills" affected with "mosaic" disease, with the idea that shoots arising later might prove to be healthy. The details of these experiments will be given elsewhere, but it may be mentioned here that no success from the practical standpoint, resulted from this treatment. Of 216 affected hills, where the bines were "pulled," 160 (*i.e.*, 74 per cent.) produced no fresh shoots, resulting, of course, in the death of the hill. Fifty-six hills produced fresh shoots, and in 40 cases these shoots were clearly affected with the "mosaic" disease. In only 5 cases, *i.e.*, in a little over 2 per cent. of the total number of hills "pulled," were the new shoots that were produced apparently healthy. The writer carried out the same treatment of diseased hills at Wye; here, out of 173 treated hills, 122 (*i.e.*, 71 per cent.) produced no fresh shoots; 32 hills produced again diseased shoots, and 7 plants, *i.e.*, 4 per cent., produced shoots which were apparently healthy.

Control Measures.—The full control of the "mosaic" disease of the hop cannot be hoped for until the exact cause of the disease and the manner of infection are known. Prof. V. H. Blackman, F.R.S., and Miss Lacey have now commenced investigations along the lines which have proved successful in other diseases of this type.

In the meantime, however, considering the havoc that "mosaic" diseases are causing in many agricultural crops and that severe outbreaks of the mosaic disease in hops have already occurred in Kent and other hop-growing counties, it is desirable that the hop-grower should take steps at once to check the spread of the disease, as far as possible, by adopting the following control measures.

1. Where the "mosaic" disease is recognised, the affected "hill" should be *grubbed up at once.* There is reason to believe that the "green-fly" (Aphis), and possibly other insects, spread the disease from an infected plant to healthy ones.

2. When an affected hill is seen, *the adjoining "hills" should be carefully scrutinised* for the detection of the first signs of the disease, and every hill showing symptoms of the disease should be grubbed up at once. A systematic examination of the hop garden should be made during June and again just before hop-picking.

3. The spread of the disease is undoubtedly taking place through the use of cuttings taken from affected hills and from hills which appear healthy and yet carry the germs of the disease. Drastic measures are necessary in order to stop this spread of the disease. Either no cuttings should be taken at all from a hop garden in which the "mosaic" disease has occurred, or, if that is impracticable, then, either (1) no cuttings should be taken from *that part of the garden* where the disease has occurred, or (2) no cuttings should be taken from the "hills" contiguous to the diseased "hill" that has been grubbed up.

The nearer the practice can be followed of not taking any cuttings from a garden where the "mosaic" disease has occurred, the greater will be the likelihood of checking the spread of this new disease.

Summary.—1. The "mosaic" disease of the hop—which is apparently similar in many respects to the well-known "mosaic" diseases of the potato, tomato, tobacco and other plants—is proving extremely destructive and very contagious.

The hop-plant once attacked never recovers and is usually killed in one or two seasons; an infected plant not grubbed up serves as a source of infection which quickly spreads the disease.

2. Observations have shown that the disease can be carried in the cuttings of hop-plants.

3. The systematic "rogueing" of hop gardens in early summer and again just before hop picking is recommended to prevent the spread of the disease.

* * * * * *

BRITISH APPLES AT THE SECOND IMPERIAL FRUIT SHOW.

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AN article dealing with the general entries, British Empire Apple Section, and with pears and grapes was published in this *Journal* for December, p. 788.

Dessert Apples.—To meet the wishes of the apple growers, Sectional Classes were provided for the Kent and Southern, the Eastern and Northern, and the West and Midland growers, and for each section a group of Judges was selected to make the awards. The Section Cards showing the marks awarded to exhibits in the Sections have already been made public, and each competitor has had a chance of discovering his strong and weak points. The prize-winning exhibits in the Sectional Classes were then rejudged for the premier awards in the classes open to growers in Great Britain. A few comments on the best may be of some educational value.

Cox's Orange Pippin.—The first class was for 6 boxes of Cox's Orange Pippin, and it would be difficult to imagine much better fruit than the winning exhibits in the three sections. All these apples were about the same size—200 to the box, packed 3—2, 8—8. All were highly coloured, well finished, and evenly packed. When judged for the Great Britain Section the Hereford exhibit proved free from blemish and slightly more uniform than the others, and gained the 1st prize by 2 points. The University of Reading exhibit secured one mark less, and one mark more than the Cox's from Cambridge, which were packed less solid. The size of apple selected in many of the other

exhibits was too small; in others so large that only 163 to the box could be packed.

At the sale all three prize winners realised much higher prices than the winning Cox's in the Empire Section. This was generally expected, for in this year's competition the best exhibits were entered in the Sectional Classes.

The Cox's Orange Pippin packed in half sieves were no less good, and both for condition of the fruit and the quality of the pack, the best exhibit came from that noted fruit growing county Devonshire. This secured first prize in the West and Midlands Section, first in the Great Britain Section, and two specials. The Herefordshire Cox's came second. The West Country thus demonstrates ability to produce good fruit where efforts are made to master the processes of grading and packing.

The average prices of Cox's Orange Pippin were as follows: —

	Average price per box (40 lb.) £ s. d.	Average price per half-sieve of 20 lb. £ s. d.
Kent and Southern Counties Section ...	1 6 7	0 12 4
East and Northern Section	1 1 3	0 10 10
West and Midlands Section	1 1 7	—

Worcester Pearmain.—The best two exhibits—the first from Hereford and the second from Cambridge—were packed 3—2, 8—7 but in each the pack lacked solidity and points were lost in both cases. As the show proceeded the condition of the fruit rapidly deteriorated, and apart from the winning exhibits realised moderate prices at the auction sale, the average being 10s 1d. per box of 40 lb.

King of the Pippins.—Good samples of this variety look well when properly packed, but really good clean samples are difficult to obtain in quantity. The exhibit from Herefordshire was by many points superior to the rest, and for colour, finish, skin quality, and general brightness it was as fine a lot of Kings as it was possible to obtain, points only being lost on wrapping and packing. This exhibit and the second prize winner (from Cambridgeshire) were packed 3—2, 7—8, which would appear suitable for this dessert variety. At the sale, the prices averaged 8s. per box for the Kent and Southern Section, 11s. per box for the Eastern Counties Section, and 6s. per box for the West and Midlands Section.

Allington Pippin.—The best exhibit of this variety also came from Hereford, and it gained because of superior colour and

brightness. East Suffolk secured the second prize. The best exhibit from Kent—at one time the home of the Allington—was placed third, points generally being lost for a slack pack. Prices were generally about 8s. to 9s. per box.

Blenheim Orange.—This apple has long been famous in the West Country, and it was general expected that the exhibits of Blenheims in the West and Midlands Section would be good. Curious to relate, however, the best Blenheims (12 boxes) were staged by the only fruit grower in Warwickshire to exhibit at the Show and there was little to choose between his two lots, which secured both first and second prizes. These apples were rather large for dessert, but their even shape, clear skin and bright colour looked tempting, and more than one visitor to the show declared these the best apples in the competition. These two exhibits realised 24s. and 21s. per box at the sale, thus supporting the judges' decision. Prices generally averaged 12s. 6d. per box of 40 lb.

Other Dessert Varieties.—Many interesting varieties were shown in the " other variety " class, such as Gascoyne Scarlet, Charles Ross (many exhibits), James Grieve, Small Newton Wonder, Wealthy Winter, Quinning, Barnack Beauty, and Rival. The names of all these were attached to the exhibits for educational purposes—a feature which made the show more attractive.

From a general consideration of the size of apple in prize exhibits, it would appear that for dessert apples the best size for packing, except for a large variety such as Blenheim, is 3—2, 7—8, though if this fails to give a tight pack it may be better to use a slightly smaller apple and pack 3—2, 8—8. The apples should be uniform in size, of the correct shape, and with a fine bright skin free from blemish and provided with plenty of colour. Boxes so packed not only secure good marks from the Judges but correspondingly satisfactory prices when sold. (For example, the Cox's Orange Pippin in the Kent Section, where three exhibits recorded by the Judges as below show standard realised but 22s., 22s. and 20s. per box by auction, but those securing marks of 68, 69, 73, 76, 82 88, 90 and 92 realised 25s., 26s., 31s., 31s., 33s., 38s., 38s. and 44s. per box; the Blenheim Orange in the West and Midlands Section, with Judges' marks of 57, 69, 73, 75, 84, 94 and 97, realised at the auction 10s., 13s., 14s., 14s., 14s., 21s. and 24s. per box.)

Cooking Apples.—*Bramley Seedling.*—Excellent samples of both green and crimson Bramleys were shown in both barrels and bushels and it was generally agreed that these packages are

more suitable than boxes for this variety. The first prize exhibit from Kent in the Great Britain Section won because of superior size, 16 apples only being needed for the top layer. The second exhibit was packed 20 to the layer. The condition generally of this variety was exceedingly good, though most apples were on the small size. It may be of interest here to compare the average prices made by the Bramleys in the barrels compared with the smaller weight in the bushels, and arranging prices sectionally they were as follows :—

	Kent Section.	*Eastern Counties Section.*	*West and Midlands Section.*
Barrels (60 lb.) ...	16/9	13/9	16/1
Bushels (40 lb.) ...	8/2	8/-	11/3

Newton Wonder.—The Newton Wonder apples were exceptionally fine and the weather conditions in 1922 proved favourable to this variety. Whether packed in barrels, bushels or boxes, the exhibits looked very attractive, this variety lending itself well to display. The best exhibit was grown in Worcestershire. The fruit was of good quality and condition and possessed plenty of colour. The packing was slightly better than that of the second, but the only full marks awarded for method of ringing in were for an unplaced Kent exhibit which had 17 apples on the top layer, finishing with one in the middle.

Prices for barrels of Newton Wonder were generally good, the average being—Kent and Southern Counties Section 16s. 8d. per barrel; Eastern Counties Section 12s. 5d. per barrel; and West and Midlands Section 15s. 11d. per barrel.

Lane's Prince Albert.—This variety has long been a popular commercial apple, but on few occasions have such excellent samples been collected as were shown in boxes, barrels and bushels on the present occasion. Competition was very keen, and only samples with bright skins and possessed of the conspicuous red stripes secured prizes. The first prize winner (Worcestershire grown) was many points superior to the others. The apples were large, the top layer consisting of but 14, of which four were in the middle. The eyes were turned towards the centre making a really attractive exhibit. Prices for Lane's were good and several exhibits made more than 20s. per barrel, whilst the average prices were as follows :—For Kent and Southern Section, 12s. per barrel; Eastern Counties Section, 13s. 5d. per barrel; and West and Midlands Section, 14s. 3d. per barrel.

Other Cooking Varieties.—In the " other variety " class, Lord Derby, a favourite in the Eastern Counties, was largely shown.

There were also Large Charles Ross and Blenheim, Gascoyne Scarlet, Wellingtons, Annie Elizabeth, and five exhibits of King Edward VII and Encore. Both of these new varieties are thought to have great commercial possibilities as late culinary varieties. Again all these exhibits bore names for educational purposes.

Of the many fine exhibits in the barrel class one lot of Lord Derby from Cambridge scored many points above the others mainly because of superior packing, which showed an exceptionally good and even finish. There were 13 apples on the top layer with three in the middle. This exhibit won two first prizes and sold for the high figure of 30s. per barrel.

The culinary apples in bushels proved an attractive exhibit. The first prize, for highly coloured good quality apples from Wisbech, was packed 20 to the layer with one in the centre. This realised 24s. per bushel. The second prize was awarded to an exhibit of King Edward VII, Cambridge grown, which sold for 16s. per bushel.

Notes.—General considerations would suggest that size. colour, quality, and good packing are the essential points for cooking apples, no matter whether for the Judges' adjudication or for sale. It was suggested that the best method of judging cooking apples would be to award the prizes to those exhibits that made the most money. Whilst exhibitors might complain if this method were adopted, a comparison showed that the Judges' section cards and the prices realised run almost parallel. both for the dessert apples, of which a few instances have been quoted, as well as for the cooking. For instance, in the class for six barrels of Lane's Prince Albert (Kent Section) the marks were 69, 73, 78, 80, 83, 86, 87, 90, 91, 92, and the auction prices 10s., 11s., 11s., 11s., 12s., 12s., 15s., 13s., 15s., 17s. For the Newton Wonder in the West and Midlands, Judges' marks were 71, 75, 79, 85, 85, 88, 89, 90, 90, 92, 96, 97, and the prices 14s., 12s., 18s., 18s., 18s., 17s., 16s., 15s., 17s., 18s., 20s., 27s. The figures run too consistently on parallel lines to be a mere accident.

The box and the half sieve for dessert apples, and the barrel and sieve for culinary, find champions and opponents in every market, and it may be interesting to give figures of the prices realised at the auction sale. These were as follows:—

There were in all 798 boxes of dessert apples which, on account of the low prices realised for the Worcester and Allington, and bad specimens of Kings, only averaged 18s. 8d. per box of

40 lb. There were 368 half sieves which realised an average of 8s. 2d. per package; which seems to indicate its value as a commercial package still of value. It must be remembered, however, that in a large majority of cases the apples in the half sieves were Cox's Orange Pippin.

The comparison amongst cooking varieties is made easier because of the more level standard of quality recognised for this purpose. There were in all 852 half barrels (60 lb.) which sold for an average price of 14s. 6d.; and 360 bushel sieves (40 lb.) which realised 8s. 7d. per package. This would indicate an advantage for the half barrel as a sound commercial package for cooking apples.

Besides the educational and immediate commercial advantage of this show to the exhibitors, it will tend to stimulate growers to improve their methods of grading and packing, when their difficulties in competing in the home markets against imported produce will become less.

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THE VALUE OF A FIRST CROSS IN THE PRODUCTION OF PORK AND BACON.

It is a commonly held view that, in the production of pork or bacon, it is a sound commercial proposition to use a first cross. The reasons advanced are twofold: (1) a suitable first cross gives an ideal side of the bacon, and (2) the first cross matures more quickly and costs less to feed.

An experiment on commercial lines carried out at the Lord Wandsworth Institution at Long Sutton, Hampshire, during the winter of 1921 is of interest in this connection, since the results of the trial indicate that a first cross does mature more quickly and is more economical to feed. Unfortunately the data available do not extend to the slaughter stage, considerations of a purely commercial nature. such as selection for breeding and marketing facilities, precluding the comparison of the data beyond the fourth month of feeding.

In the trial, nine pure bred Large Black pigs were compared with nine Berkshire-Large Black crosses. At the commencement of the trial, 13th October, 1921, the pigs were eight weeks old. The pigs in both lots received identical treatment throughout,

both with regard to feeding and management, and the results obtained may be safely attributed to the difference due to the first cross.

For the first two months both lots of pigs received the same quantity of food, but as the cross breds thrived much better, it was found necessary to feed them a little more generously in the latter stages of the trial. In both cases, the pigs were given as much meal as they would eagerly clear up at each meal. The exact particulars as to meals fed are as follows:—

Pure Breds.

1st 28 days. Consumed 218½ lb. toppings, 105¾ lb. barley meal, 105¾ lb. maize germ meal—430 lb. mixed meals, and 112 lb. skim milk.

2nd 28 days. Consumed 181½ lb. toppings, 237¼ lb. barley meal. 237¼ lb. maize germ meal, 89 lb. palm kernel meal=745 lb. mixed meals, plus 112 lb. skim milk.

3rd 28 days. Consumed 1,024 lb. of meal consisting of 357½ lb. palm kernel. 309⅔ lb. maize germ and 357⅙ lb. barley meal, together with 112 lb. skim milk and 112 lb. green kale.

In 29 days. Consumed 1,220 lb. of meal consisting of equal parts of palm kernel, maize germ and barley meal, together with 4 lb. of kale, 73 lb. mangolds and 120 lb. skim milk.

Cross Breds.

1st 28 days. Consumed 218½ lb. toppings, 105¾ lb. barley meal, 105¾ lb. maize germ meal=430 lb. mixed meal, plus 112 lb. separated milk.

2nd 28 days. Consumed 181½ lb. toppings, 240¼ lb. barley meal, 240¼ lb. maize germ meal, 92 lb. palm kernel meal=754 lb. meal, plus 112 lb. skim milk.

3rd 28 days. Consumed 1,139 lb. of meal consisting of 399⅔ lb. palm kernel, 399⅔ barley meal, 339⅔ lb. maize germ meal, together with 112 lb. of skim milk and 112 lb. kale.

In 29 days. Consumed 1,444 lb. of meal consisting of equal parts of palm kernel, maize germ and barley meal, together with 4 lb. of green kale, 73 lb. mangolds and 120 lb. skim milk.

The weights of the pigs were as follows:—

Pure Breds.

age.	lb.
8 weeks (Beginning of trial)	232
End of 1st 28 days	408
,, ,, 2nd 28 days	655
,, ,, 3rd 28 days	964
,, ,, final 29 days	1,279

Cross Breds.

age.	lb.
8 weeks (Beginning of trial)	271
End of 1st 28 days	451
,, ,, 2nd 28 days	718
,, ,, 3rd 28 days	1,083
,, ,, final 29 days	1,502

The nine pure bred pigs gained 1,047 lb. during the trial and consumed 3,419 lb. of mixed meals plus 456 lb. of skim milk, 116 lb. of green kale and 73 lb. of mangolds = approximately 3,503 lb. of food reckoned as mixed meals.

The nine cross bred pigs gained 1,231 lb. during the trial and consumed 3,767 lb. of mixed meals plus 456 lb. of skim milk, 116 lb. of green kale and 73 lb. of mangolds = approximately 3,851 lb. of food reckoned as mixed meals.

From the above data, it will be seen that the cross breds matured more quickly. For each lb. of live weight increase put

on by the pure breds, 3.3 lb. of meal were required, whereas the cross breds required only 3.1 lb. of meal for every lb. of live weight increase.

These results indicate that, where circumstances allow, the *first cross* between two pedigree pigs is desirable if used for commercial purposes. It must, however, be clearly borne in mind that these remarks apply only to the *first cross* and do not apply to all cross breds, *i.e.*, cross breds resulting from second or third crosses, or what can be regarded as a mongrel type of pig.

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DOES GOOD FARMING PAY?

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The following note has been contributed by Mr. Orwin in reply to Sir John Russell's observations on the subject in the issue of this JOURNAL *for November,* 1922, *p.* 752.

IN the November *Journal* there appears an article by Sir John Russell, under the title " Does Good Farming Pay? " which raises a point of greatest importance to farmers to-day. Applying to the words their strictest meaning the answer to the question can only be " Yes," because if farming does not pay, it cannot be good. It is evident from the context, however, that for the purpose of the article " good farming " is taken as being synonymous with " high farming "—the general truth of which is open to question.

Reference is then made to a series of very interesting experiments conducted by Lawes, on the manuring of wheat, which were used by him to illustrate the Law of Diminishing Returns as applying to agriculture. Those experiments had long been buried and forgotten in an obscure paper until they were dug up a few years ago by Sir Daniel Hall and re-stated by him in graphic form. In them plots of wheat were given equal treatment except that varying quantities of nitrogenous fertilisers were applied, the dose increasing at a uniform rate from plot to plot. The results showed that whereas the manurial costs rose from plot to plot on a uniformly ascending scale, the crop increase due to additional fertiliser was less and less, so that ultimately a point was reached at which the increase in crop was insufficient to pay for the increase in fertiliser.

Sir John Lawes, starting apparently with a very unproductive soil, used most extravagant quantities of nitrogenous manure for the purposes of his experiment, and accordingly Sir John Russell suggests that the results have no value as a guide to the farmer upon the wisdom or otherwise of " high farming " to-day. In support of this suggestion he quotes a recent experiment (1921) carried out at the Midland Agricultural College, upon potatoes, where the manures used bore a closer relation, as to quantity, to current farming practice, and which he interprets to prove that " if it pays to grow a crop at all it pays to grow a good one." (Again the writer must be presumed to be judging of goodness by a quantity standard only.)

The results of the Midland Agricultural College experiment, as stated by Sir John Russell, are as follows :—

Plot.	Manuring.		Yield in tons per acre.	Percentage Ware.	Percentage Seed.	Value of Crop at £6 per ton. Seed and Chats at £2 per ton.	Cost of extra manure at 4/- cwt. for superphosphate, 15/- cwt. Sulph. Amm., 15/- cwt. Sulphate of Potash.	Profit or loss from additional dressing.
	Dung.	Artificials.				£ s. d.	£ s. d.	£ s. d.
1	12 tons	6 cwt.	11·31	53·1	42·3	46 13 0	--	—
2	12 ,,	8 ,,	13·63	56·9	39·3	58 5 0	0 17 0	+10 10 0
3	12 ,,	10 ,,	14·36	60·6	35·7	63 10 0	1 14 0	+15 3 0
4	12 ,,	12 ,,	13·19	61·7	33·2	58 18 0	2 11 0	+ 9 14 0
5	12 ,,	14 ,,	13·18	52·9	41·2	54 5 0	3 8 0	+ 4 4 0
6	12 ,,	16 ,,	11·34	58·4	38 3	49 3 0	5 4 0	— 1 15 0

So far from proving that Lawes' work and conclusions " cannot properly be quoted in relation to the modern problem " these experiments are an admirable confirmation of them. They show, in connection with a different crop and with a scheme of manuring more closely related to normal farming practice, results exactly comparable with his. The rate of crop-increase, which is very considerable under the smaller doses of manure, is slower and slower as more and more fertiliser is applied.

Now the practical application of Lawes' experiment is not that the farmer should never attempt to increase his crops in times of low prices, but that the measure of the attempt must always be determined in relation to the market valuation of the product concerned. In other words, the profitableness of any

expenditure upon fertilisers is dependent upon current prices. This is exactly what is proved in the experiment cited by Sir John Russell. The prices quoted for the potato crop by him are now nothing more than a happy memory. The figures given in the press to-day for Arran Chiefs are from £2 10s. to £3 5s. per ton, for ware, *ex* Borough Market, and if we take these figures as equivalent to an average price of £2 per ton on the farm, and then allow £1 for chats we shall have, probably, a close approximation to the facts. Recalculating Sir John Russell's results in these terms we get the following figures :—

Plot.	*Profit or loss from additional dressings at prices used by Sir John Russell* :— £ s. d.		*Profit or loss from additional dressings at prices current to-day* :— £ s. d.
2	+ 10 15 0	......	+ 3 4 0
3	+ 15 3 0	......	+ 4 0 0
4	+ 9 14 0	......	+ 1 9 0
5	+ 4 4 0	......	0 13 8
6	— 1 15 0	......	— 3 14 3

At Sir John Russell's prices the earlier increments of fertiliser pay, whilst the later ones do not; at prices now current the first increment shows a profit, the second pays its way as compared with the first, th third shows a loss compared with either first or second, whilst the two last show an actual loss. What better confirmation could there be of Sir John Lawes' figures? When prices are low the farmer cannot afford to go out for the increased production that would pay him at higher prices.

There is, however, still another consideration involved, and that a most important one. Taking Sir John Russell's figures for the potato crop as they stand, the whole value of his conclusions as to profit and loss depends upon the assumption that there was a profit (or, at all events, no loss) on the production of the basic crop on Plot 1. In 1921 farming costs reached their maximum, and it may well be that a crop of potatoes amounting to 11.31 tons which sold for £46 13s. was produced at a loss. Knowledge of the total cost of the basic crop is fundamental to the proper interpretation of the table : without it the whole experiment and others on similar lines are really worthless as regards the purpose to which they are applied here.

At Rothamsted, in 1920, the cost of the potato crop was £57 9s., and the yield about 5 tons. Labour, the principal item in cost, had risen in 1921 by about 10 per cent. contrasted with the previous year, so that it may be assumed that the crop in 1921 cost well over £12 per ton for ware and chats together.

when the market value, according to the table, was £6 per ton for 58 per cent. of the crop, and £2 per ton for the remainder. Even if the crop in the Midland experiment cost no more for nearly twice as much in produce—which is unlikely—it is clear that its cultivation must have involved a heavy loss, and that none of the "profits" indicated as the result of the increasing manuring ever materialised. It is stated in the article that "it is quite obvious that the heaviest dressing (16 cwt. artificials per acre in addition to 12 tons farmyard manure) has not paid; nor has 14 cwt. paid as well as 12 cwt.; but it would be quite wrong to argue that therefore a farmer should not use artificials at all." The only possible argument, however, is that with costs on the scale obtaining in 1921 and markets as they were no system of manuring or anything else could produce potatoes at a profit. When we come to substitute crop values prevailing to-day for those used by Sir John Russell, and to realise that the basic plot produced potatoes of a total value of no more than £17 per acre, the fallacy underlying the attempt to make the crop pay by spending more money needs no argument.

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NOTES ON MANURES FOR JANUARY.

SIR JOHN RUSSELL, D.Sc., F.R.S.,
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Town Refuse as Manure.—Further particulars have been furnished of the town refuse material prepared by the County Borough of Halifax. An analysis has already been given in the *Journal* (Nov., 1922, p. 685), showing that it contains 21.7 per cent of organic matter and 2.18 per cent. of nitrogen: it is prepared by mixing the riddled dust from bin refuse with the contents of the pail closets, and the resulting product is comparatively free from odour and is easily handled. It is understood that some 16,000 tons per annum could be prepared, which would be a useful addition to the fertiliser resources of the district. A cheap organic manure is a great help in farming.

Arable Crops on ploughed out Grassland.—It is well recognised that improvement in grassland effected by basic slag is continued in arable crops taken if, and when, the land is broken up. This is an important point where the rotation involves leaving the land in grass for several years, as often happens in

the west and north, the grass then being broken up for a succession of arable crops. An interesting illustration is furnished by the experiments made by Mr. A. W. Oldershaw at Saxmundham. A grass area was divided into two parts: one was manured with 10 cwt. per acre of basic slag in 1904 and again in 1912; the other was left unmanured. Both parts were grazed with sheep. The slagged one did the better and gave a profit after paying for the manure, which averaged 17s. 2d. per acre each year. The land was then broken up and cropped: the slagged area still continues to give the heavier crops. The results have been as follows:—

	1919 Mixed Beans and Peas.	1920 Wheat.	1921 Barley.	Crop 1922 Mangolds.
Plot 1. No Manure on grass 1904 and 1912	29.7 bush. Corn 42 cwt. Straw	29½ bush. Corn 35 cwt. Straw	31½ bush. Part of plot sub-oiled in Feb., 1922	tons cwt. Subsoiled ... 23 15 Not subsoiled 23 15
Plot 2. 10 cwt. Basic Slag in 1904 and again in 1912	40 bush Corn 62 cwt. Straw	38.8 bush. Corn 45 cwt. Straw	43½ bush. Part of plot subsoiled in Feb., 1922	Subsoiled ... 28 4 Not subsoiled 26 10

The additional yields on the slagged area are no doubt connected with the development of wild white clover, though it must also be remembered that the particular type of soil at Saxmundham responds to phosphates.

It is interesting to note that subsoiling had no visible effect on the yield of mangolds on the unslagged plot, while an additional 34 cwt. were produced on the subsoiled part of the slagged plot.

Effect of Manures on Barley Crop.—An experiment was carried out this year by the Rothamsted Experimental Station under the Research Scheme of the Brewers' Institute in which barley was grown on a number of farms under fertiliser treatment designed to meet various special conditions. The results already known afford interesting evidence of the room for improvement in the fertiliser treatment of even so well understood a crop as this.

An interesting case is furnished from a well managed farm on very light land in Suffolk, on which barley has been well and successfully grown for a number of years. The average yield on the farms in the immediate neighbourhood was this year

about 20 bushels per acre. On the experimental plots the yields were as follows :—

	bush. per acre.
No manure	16
Complete artificials (a good general dressing)	21½
Nitrogen and Potash only (specially suited to light land)	27½

These figures illustrate the important principle that the manurial scheme should suit the local conditions: the good general all-round manure is not as effective as the one specially adapted to the particular field. The difference in result between the special and the general manure is easily explained: phosphates are well known to hasten the ripening of crops, and they may actually prove detrimental to the yield on a light sandy soil where cereals usually ripen off quite early enough. Potash, on the other hand, encourages the prolonged activity of the plant's life process, which is the thing needful on a light soil. A combination of nitrogenous and potassic fertiliser would therefore be expected to act better for barley *on a light sandy soil in dry condition* than a complete fertiliser. The safest principle in manuring is to start with a good general mixture as basis, and then modify it to suit the particular farm by reducing the quantity of constituents not particularly needed there—if necessary omitting them altogether—and increasing the quantity of constituents which are particularly effective.

Manuring for Potatoes.—The results of last year's experiments are beginning to come in and they already show certain features of interest. During the War years some of the potato growers, finding they obtained fair or even good crops without the use of potassic fertilisers, began to ask whether potash really is necessary for potatoes. Experiments have therefore been started to see what effects are produced. The yields at Rothamsted this season were :—

Without Farmyard Manure.

	tons per acre.
No manure	3·0
Artificials *without* potash: Superphosphate 6 cwt., Sulphate of ammonia 2 cwt. per acre	2·5
Artificials *with* potash as above + sulphate of potash 2 cwt. *or* muriate of potash 1·7 cwt. per acre ...	8·3

With Faryard Manure.

(10 tons per acre).

	tons per acre.
Artificials *without* potash: superphosphate 4 cwt., sulphate of ammonia 1¼ cwt.	8·0
Artificials *with* potash as above	
+ sulphate of potash 1½ cwt. ...	9·6
+ muriate of potash 1·3 cwt. ...	9·2

During this season therefore the effect of potash has been very marked, especially in the absence of farmyard manure; while even with a good dressing of this substance the effect was still shown.

The results bring out a feature which was shown at several of the centres this season: in absence of farmyard manure, or where small dressings only can be given, the artificials must be very carefully chosen if any useful result is to be obtained. The mixture of 6 cwt. of superphosphate and 2 cwt. of sulphate of ammonia proved wholly unsuitable: from the outset the plots could be picked out by the dark, unhealthy look of the leaves and the stunted growth of the plants: indeed, the appearance was inferior to that of the wholly unmanured plot, and in the end the crop was the poorest of the set, being only on an average 2½ tons per acre, while the unmanured plots had yielded on an average 3 tons per acre. When the fertiliser, however, was made complete by the addition of potash the yield jumped from 2½ tons to 8 tons 6 cwt.—an addition of nearly 6 tons of potatoes as a result of adding 2 cwt. of sulphate of potash or 1.7 cwt. of muriate of potash. Experience at other centres suggests that this mixture might be even further improved.

Where farmyard manure is added the crops are somewhat larger, but as the limit for potatoes on our soil seems to be about 10 tons per acre there was not much margin left for improvement, and the addition of potash to the incomplete artificials has raised the yield from 8 tons per acre to 9 tons 12 cwt. in the case of sulphate of potash, or 9 tons 4 cwt. in that of muriate of potash—an additional 1 ton 12 cwt. of potatoes for the use of 1½ cwt. of sulphate of potash, or 1 ton 4 cwt. for the use of 1⅓ cwt. of muriate of potash—quite a useful increase which at normal prices would have given a good profit.

Does Manuring Pay?—The above paragraphs show that the expenditure on the manure—provided a suitable mixture was used—was well justified. The 8½ or 9½ tons of potatoes per acre will at present prices not bring a profit, but they will not involve us in the serious loss attached to the yields of 2½ or 3 tons per acre which we should have obtained had we tried to save the manure bill. If we had known that prices would be down to £2 per ton to the grower we should not of course have touched the potato crop, but having grown it we have come out better with the big crop obtained by the use of a proper fertiliser mixture, than we have from the smaller crops grown with less or no fertiliser. The outgoings are not widely different in the

two cases, but the incomings are. The way to meet the difficulty is to bring down the other charges and so reduce the total cost of production.

Prices of Artificial Manures.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are nett cash for prompt delivery.

DESCRIPTION	Price per ton				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	...	13.15	13. 5	13. 5	17. 1
„ „ Lime (N. 13 per cent.)	...	...	...	11.17	18. 3
Sulphate of Ammonia, ordinary (A. 25¼ per cent.)	15.10*	15.10*	15.10*	15.10*	(N)14·11
„ „ „ neutral (A. 25¾ per cent.)	16.13*	16.13*	16.13*	16.13*	(N)15.8
Kainit (Pot. 12½ per cent.)	...	..	2.12	2. 0	3. 2
French Kainit (Pot. 14 per cent.)	2. 5	2. 1	...	2. 5	3. 3
Sylvinite (Pot. 20 per cent.)	...	...	...	3. 2	3. 1
Potash Salts (Pot. 30 per cent.)	...	...	...	4.15	3. 2
Muriate of Potash (Pot. 50 per cent.) ...	...	10. 7‡	9. 0	9. 0	3. 7
Sulphate of Potash (Pot. 48 per cent.) ...	...	13.12‡	12. 0	12. 0	5. 0
Basic Slag (T.P. 30-32 per cent.)	3.15§	...	...	4· 2§	2. 8
„ „ (T.P. 24-26 per cent.)	...	21.13§	...	...	...
„ „ (T.P. 20-22 per cent)	2.12§	2. 5§	2.15§	21.5§	2. 7
„ „ (T.P. 16-18 per cent.)	2. 2§	...	2. 8§	12.3§	3. 2
Slag Phosphate (T.P. 60 per cent.) ...	6. 7§	...	..	6.15§	2. 3
„ „ (T.P. 50 per cent.) ...	...	...	5.10§	5.15§	2. 4
„ „ (T.P. 40 per cent.) ...	4. 7§	...	...	...	...
Superphosphate (S.P. 35 per cent.) ...	3.17	...	4. 2§	3.12	2. 1
„ (S.P. 30 per cent.) ...	3. 7	3. 0	3.10§	3. 5	2. 2
Bone Meal (T.P. 45 per cent.)	9.10	9.10†	9. 0	9. 0	...
Steamed Bone Flour (T.P. 60 per cent.) ...	8.10†	8. 5†	8. 0	7. 5	...
Fish Guano (A. 9-10, T.P. 16-20 per cent.)...	12 15	...	12. 5	12. 5	...

Abbreviations: N.=Nitrogen; A.=Ammonia; S.P.=Soluble Phosphate; T.P.= Total Phosphate; Pot.=Potash.

* Delivered in 4 ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ At Goole.

§ Prices include cost of carriage from works to town named. Cost to purchasers in other districts will be greater or less according to the distance of different purchasers from the works.

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NOTES ON FEEDING STUFFS FOR JANUARY.

E. T. HALNAN, M.A., Dip. Agric. (Cantab.),

Ministry of Agriculture and Fisheries.

Mineral Mixtures for Stock.—The body of a farm animal contains from 3 to 5 per cent. of mineral substances, which are chiefly present in the bones, but are also present in lesser amounts in the flesh and the body fluids.

DESCRIPTION.	Price per Qr.		Price per Ton.	Manurial Value per Ton.	Cost of Food Value per Ton.	Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv.	Price per lb. Starch Equiv.
	s.	lb.	£ s.	£ s.	£ s.		s.	d.
Wheat, British	44/6	504	9 18	0 18	9 0	71·6	2/6	1·34
Barley, British Feeding	31/–	400	8 14	0 14	8 0	71	2/3	1·20
„ American „	32/3	400	9 1	0 14	8 7	71	2/4	1·25
„ Danubian „	32/–	400	8 19	0 14	8 5	71	2/4	1·25
„ Persian „	30/9	400	8 12	0 14	7 18	71	2/3	1·20
Oats, English White	32/6	336	10 17	0 16	10 1	59·5	3/5	1·83
„ , Black & Grey	29/6	336	9 17	0 16	9 1	59·5	3/1	1·65
„ Scotch White	36/–	336	12 0	0 16	11 4	59·5	3/9	2·01
„ Irish, Black	27/–	320	9 9	0 16	8 13	59·5	2/11	1·56
„ Canadian No. 2 Western	33/–	320	11 11	0 16	10 15	59·5	3/7	1·92
„ „ No. 2 Feed	30/–	320	10 10	0 16	9 14	59·5	3/3	1·74
„ American	28/3	320	9 18	0 16	9 2	59·5	3/1	1·65
„ Argentine	29/6	320	10 6	0 16	9 10	59·5	3/2	1·70
„ Chilian	†31/3	320	10 19†	0 16	10 3	59·5	3/5	1·83
Maize, Argentine	38/–	480	8 17	0 15	8 2	81	2/–	1·07
„ American	38/–	480	8 17	0 15	8 2	81	2/–	1·07
Beans, English Winter	53/–	532	11 3	1 17	9 6	67	2/9	1·47
„ Rangoon	8/6	112	8 10	1 17	6 13	67	2/–	1·07
Peas, English, Dun	62/–	504	13 16	1 13	12 3	69	3/6	1·87
„ „ Maple	90/–	504	20 0	1 13	18 7	69	5/4	2·86
Rye, Home-grown	33/–	504	7 7	0 18	6 9	71·6	1/10	0·98
Millers' offals—								
Bran, British	—	—	7 5	1 12	5 13	45	2/6	1·34
Broad Bran	—	—	8 0	1 12	6 8	45	2/10	1·52
Fine middlings (Imported)	—	—	9 12	1 6	8 6	72	2/4	1·25
Coarse middlings (British)	—	—	8 2	1 6	6 16	64	2/2	1·16
Pollards (Imported)	—	—	7 2	1 12	5 10	60	1/10	0·98
Barley Meal	—	—	10 15	0 14	10 1	71	2/10	1·52
Maize „	—	—	10 10	0 15	9 15	81	2/5	1·29
„ Germ Meal	—	—	10 10	1 2	9 8	85·3	2/2	1·16
„ Gluten-feed	—	—	9 10	1 12	7 18	75·6	2/1	1·12
Locust Bean Meal	—	—	8 0	0 11	7 9	71·4	2/1	1·12
Bean Meal	—	—	13 0	1 17	11 3	67	3/4	1·78
Fish „	—	—	14 10	5 1	9 9	53	3/7	1·92
Linseed	—	—	20 10	1 16	18 14	119	3/1	1·65
„ Cake, English (9°/。 oil)	—	—	13 17	2 5	11 12	74	3/2	1·70
Soya Bean Cake (6% oil)	—	—	12 5	3 3	9 2	69·1	2/8	1·43
Cottonseed „ English (5°/。 oil)	—	—	7 12	2 1	5 11	42	2/8	1·43
„ „ Egyptian (5°/。 oil)	—	—	7 10	2 1	5 9	42	2/7	1·38
Coconut Cake (6°/。 oil)	—	—	9 0	1 16	7 4	73	2/–	1·07
Ground-nut Cake (7°/。 „)	—	—	10 10	2 2	8 8	56·8	2/11	1·56
Decorticated Ground-nut Cake (9°/。 oil)	—	—	13 0	3 4	9 16	73	2/8	1·43
Palm Kernel Cake (6°/。 oil)	—	—	7 0†	1 7	5 13	75	1/6	0·80
„ „ Meal (2°/。 „)	—	—	7 0	1 8	5 12	71·3	1/7	0·85
Feeding Treacle	—	—	4 10	0 10	4 0	51	1/7	1·85
Brewers' grains, dried, ale	—	—	8 0	1 8	6 12	49	2/8	1·43
„ „ „ porter	—	—	7 10	1 8	6 2	49	2/6	1·34
„ „ wet, ale	—	—	1 10	0 11	0 19	15	1/3	0·67
„ „ wet, porter	—	—	1 4	0 11	0 13	15	–/10	0·45

† At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of November and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose coconut cake is offered locally at £10 per ton. Its manurial value is £1 16s. per ton. The food value per ton is therefore £8 4s. per ton. Dividing this figure by 73, the starch equivalent of coconut cake as given in the table, the cost per unit of starch equivalent is 2s. 3d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·21d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

The chief elements present are calcium, phosphorus, potassium, sodium, magnesium, sulphur and chlorine, all, of course, present in a combined state.

Source of Mineral Substances.—The mineral substances, or ash, are derived chiefly from the food materials fed to farm animals. An ordinary mixed ration supplies all the mineral substances necessary to animals except sodium and chlorine, which are generally given in the form of rock salt (sodium chloride).

In ordinary grains and their by-products, calcium is deficient, but it is abundant in bone and meat meal and legume hays.

Phosphorus is abundant in bone and meat meal, bran and middlings, oil cakes, fish meal, beans and peas.

Stock likely to require Mineral Feeding.—It has been noted above, that an ordinary mixed ration will, as a general rule, contain all the mineral substances necessary for the maintenance of health, except in the case of sodium and chlorine, for which rock salt is generally supplied. Pigs, however, are largely fed on grains and grain by-products, and their rations are therefore likely to be deficient in calcium, which element is very necessary for the production of bone. In order to correct for this absence of calcium, either leguminous hay such as clover, lucerne and vetches, should be given, or some mineral substance such as steamed bone flour, should be added to the ration.

In addition there is a heavy demand for mineral substances in the case of all young growing stock, animals heavy in young, and dairy cows in milk. It is therefore advisable to supply these classes of stock with a suitable mineral mixture.

The usual and cheap sources of mineral substances are small coal, chalk, rock salt and steamed bone flour, and it is considered sound practice to have these substances always available in troughs in the feeding yards.

Recent experiments carried out by Professor Evvard at the Iowa Experiment Station, U.S.A., have emphasised the value of mineral mixtures for fattening pigs. Twelve groups of pigs were fed on rape pasture and received in addition supplemental feeds of maize, maize germ meal, linseed oil meal, and meat meal tankage. Different mineral mixtures were used, the check groups (20 pigs) receiving no mineral mixture. The pigs weighed 53 lb. at the beginning of the experiment and 225 lb. at the end.

Professor Evvard found that all groups receiving minerals did better than the no mineral groups. The gains were more rapid,

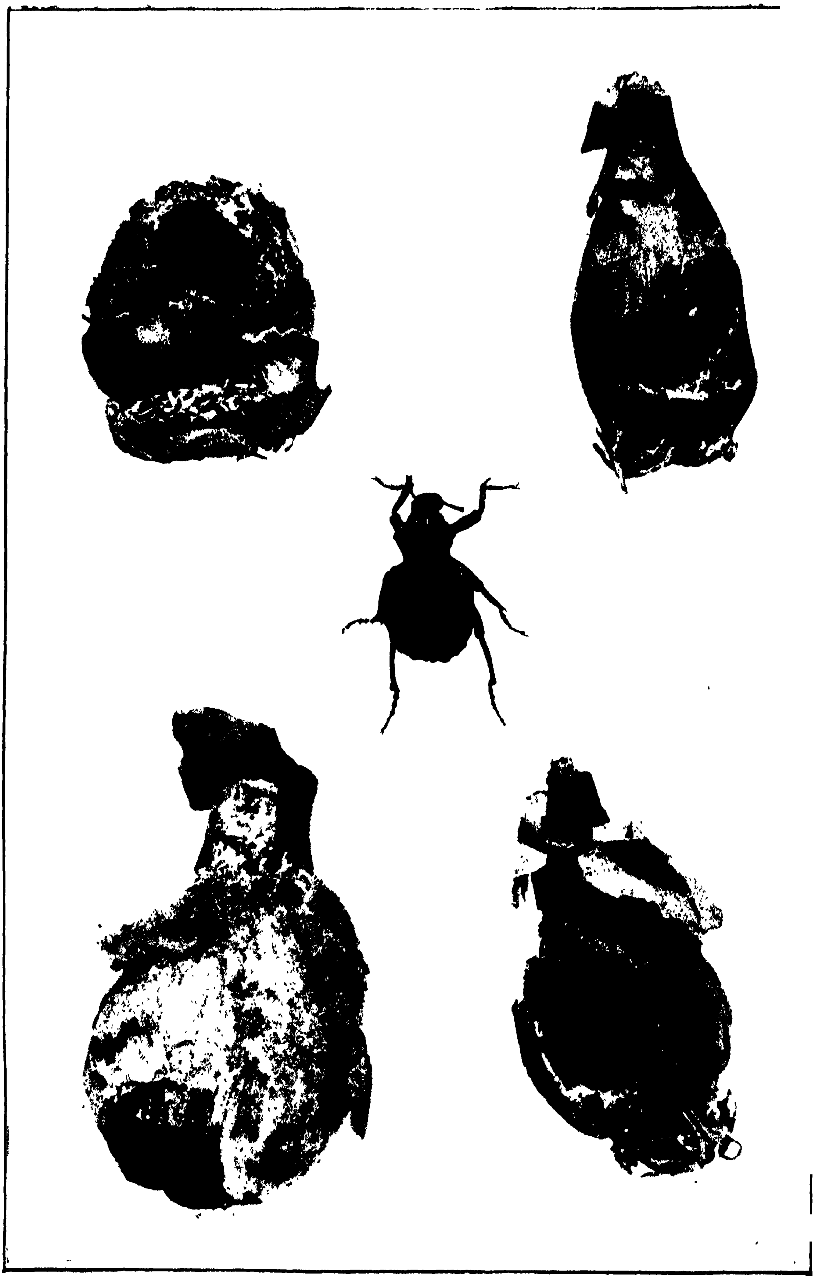

FIG. 1.—Snowdrop Weevil (*Brachycerus* sp.) with damaged bulbs. (*Twice natural size.*)

the appetite better and the feed requirement per 100 lb. gain made was less. Self-feeding the minerals is the easiest method to adopt, but where hand feeding is necessary 1 lb. of minerals per month is a good allowance.

The two best mineral mixtures used in the test consisted of :—

(1) 50lb. highly ground limestone ; 50 lb. common flake salt.

(2) Salt, 34 lb. ; spent bone black, 29 lb.; wood ashes, 14 lb.; sulphur, 11 lb.; limestone, 11 lb. ; potassium iodide, 5 oz.

The check groups required 473 lb. of food for every 100 lb. gain, the croups getting mineral mixture (1) 388 lb. food for 100 lb. gain, and the group getting mineral mixture (2) 383 lb. food per 100 lb. gain.

These experiments indicate very clearly that for pigs fattening out at about 200 lb. a very material advantage will ensue from the feeding of suitable mineral mixtures.

It is obvious, of course, that the need for mineral substances will vary according to the nature of the foods fed, and the results obtained above will not necessarily hold good for a different food mixture. The results, however, are sufficiently striking to merit serious consideration by all stock feeders.

FARM VALUES.	Value per Ton on Farm.		Manurial Value per Ton.		Food Value per Ton.		Starch Equivalent per 100 lbs.	Value per unit S.E.	Market Value per lb. S.E.
	£	s	£	s.	£	s		s. d.	d
Wheat	8	1	0	18	7	3	71·6	2/-	1·07
Oats	6	15	0	16	5	19	59·5	2/-	1·07
Barley	7	16	0	14	7	2	71	2/-	1·07
Potatoes	2	0	0	4	1	16	18	2/-	1·07
Swedes	0	17	0	3	0	14	7	2/-	1·07
Mangolds	0	15	0	3	0	12	6	2/-	1·07
Good Meadow Hay	4	19	0	16	4	3	31	2/8	1·43
Good Oat Straw	2	13	0	8	2	5	17	2/8	1·43
Good Clover Hay	5	9	1	4	4	5	32	2/8	1·43
Vetch and Oat Silage	2	2	0	9	1	13	14	2/4	1·25

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A WEEVIL DESTRUCTIVE TO SNOW-DROP BULBS.

From the Pathological Laboratory.

WHEN a consignment of snowdrop bulbs imported in July of the present year from Smyrna was inspected under the Destructive Insects and Pests Order, the Inspector (Mr. Southwell) discovered that a considerable number of the bulbs were infested by larvæ of an unknown weevil. The grubs were white in colour, as large as those of the Narcissus Fly, and were causing a very similar type of damage except that the destruction of the bulbs

was more complete. Specimens were received at the Pathological Laboratory and have now turned into adult beetles—stout black weevils almost half-an-inch in length which have been identified as a member of the genus *Brachycerus*. No representative of this genus is known in Great Britain and it has yet therefore no English name.

In the countries bordering the Mediterranean and also in Russia several kinds of *Brachycerus* are known, and in all cases in which their habits have been studied they have proved to be bulb feeders—three species for instance attack onion or garlic, and another *Scilla*. It is quite uncertain if the new weevil would be able to establish itself in Britain but taking into account the damage done by the Narcissus Fly, also a representative of a Mediterranean genus, it is clearly unwise to allow the insect any chance of spreading, and with the cordial co-operation of the importers, steps have been taken to ensure the destruction of all weevils in the consignment. Snowdrops themselves may not have any great economic value but the fact that species of *Brachycerus* also attack onions renders the matter of more importance, and it is satisfactory that the danger in this particular instance no longer exists. The Ministry propose to continue the inspection of imported bulbs coming from Mediterranean districts.

* * * * * *

AGRICULTURAL RETURNS, 1922:
PRODUCE OF POTATO AND ROOT CROPS IN ENGLAND AND WALES.

THE following preliminary statement showing the estimated total produce and yield per acre of the potato and root crops in England and Wales in 1922, with comparisons for 1921, and the average yield per acre of the ten years 1912-1921, was issued on 28th November, 1922:—

Crops.	Estimated Total Produce.		Acreage.		Average Estimated Yield per Acre.		Average of the Ten Years 1912-21.
	1922.	1921.	1922.	1921.	1922.	1921.	
	Tons.	*Tons.*	*Acres.*	*Acres.*	*Tons.*	*Tons.*	*Tons.*
Potatoes	3,986,000	2,958,000	561,177	557.800	7·1	5·3	6·0
Turnips and Swedes.	10,890,000	6,608,000	819,961	893,176	13·3	7·4	12·3
Mangold	8,555,000	6,251,000	421,458	373,065	20·3	16·8	18·7

Potatoes.—The planting of potatoes was late on the whole, and early crops suffered from the spring drought and late frosts. Those lifted before the rains gave light yields, but there was much improvement later. Main crops kept healthy and vigorous throughout the growing period, and when lifted the tubers were large, with little disease showing. The bulk of the crop was secured in good condition during the dry weather of October. The yield per acre of potatoes is estimated at 7.1 tons, or 1¾ tons per acre more than last year, and rather more than one ton per acre above the average of the ten years 1912-21. This year's yield is the highest recorded since these returns were first collected in 1885, the previous best being 6.9 tons per acre in 1908. Crops were well above average in all parts of the country, except in some of the north-western counties, where the yields were only slightly better than usual. The total production of potatoes on agricultural holdings in England and Wales is estimated at 3,986,000 tons, or more than one million tons greater than in 1921, and 50 per cent. above the pre-war average.

Turnips and Swedes.—In the west of the country there was much difficulty in obtaining a plant of swedes, as fly was very troublesome; but attacks of fly were not severe in the east. Turnip sowing was delayed in many districts as the soil was too dry until the end of June, but good plants were then obtained, as a rule. Crops, however, remained backward throughout the summer in the west of the country, and the roots are small; but in the east and south both turnips and swedes did well. The total production of turnips and swedes, 10,890,000 tons, is some 4¼ million tons greater than the very poor production of last year, but is more than one million tons below the average of the ten years 1912-21, as a result of the reduction in area. The yield per acre is estimated at 13.3 tons, or one ton above average, and practically six tons heavier than in 1921. The eastern counties yielded on the average 3 tons per acre more than usual, but the north-western counties were deficient by a similar amount. In Wales the yields were 2½ tons per acre below average.

Mangolds.—Mangolds also did much better in the east than elsewhere; in the north and west the roots are on the small side as a result of lack of sun, but crops were generally harvested under favourable conditions. On the whole this crop yielded well, giving 20.8 tons per acre, or 1½ tons more than the 10-year mean, and 3½ tons more than last year. Crops were

very heavy in the eastern and south-eastern counties, where yields were more than 5 tons and 3 tons per acre respectively above average. In the west midlands and south-west crops were variable, but about average on the whole; whilst in the north and in Wales yields were about 1½ to 2 tons per acre below average. The total production, 8,555,000 tons, is 2¼ million tons greater than last year, and nearly one million tons above the 10-years' average.

The very satisfactory crops of roots are welcome in view of the light hay crop, and it is expected that in most districts the supply of winter keep for live stock, though not plentiful, will be sufficient.

* * * * * *

University Course in Milk Recording.

BY arrangement with the authorities of University College, Reading, a special course of instruction in milk recording was held in the spring of 1922, intended mainly for students who desired to obtain employment as milk recorders under the Ministry's Milk Recording Scheme. Twenty-four students took the course and 17 passed the examination held at its close. Four of the successful students were already employed as recorders of Milk Recording Societies, and twelve others were desirous of taking up such appointments, chiefly with a view to gaining experience.

Arrangements have been made to hold a similar course of instruction at University College, Reading, from 27th February to 16th March, 1923, provided that a sufficient number of students apply for admission, the number of entries being limited to 24. A syllabus showing full particulars of the course may be obtained on application to the Faculty of Agriculture, University College, Reading. The course includes lectures on milk, its nature and composition, on bacteria and their relation to milk, testing of milk, and the principles and practice of milk recording; and practical work on actual milk recording of a comprehensive character, including food records, cost of foods, and cost of food per gallon of milk. The tuition fee will be £3 3s. Board and residence is obtainable in the neighbourhood at rates varying from £1 15s. to £2 5s. a week, and a list of such lodgings is obtainable from the College.

Preference will be given to students who are either already milk recorders under the Ministry's scheme or who intend to apply for such posts. It is not possible to give any indication as to what vacancies for milk recorders may arise, nor can any

guarantee be given that students will in fact obtain employment as milk recorders. The names of successful students will, however, be circulated by the Ministry to all Milk Recording societies in order that preference may be given by societies to these students on the occasion of filling a vacancy. The appointments carry salaries, ranging usually from £150 to £250 per annum, and they afford to young agriculturists a unique opportunity of acquiring a practical knowledge of dairy farming, often of the best type, as carried out on a variety of farms.

* * * * * *

University Course in the Production and Handling of Milk.

THE Ministry has been informed by the authorities of University College, Reading, that arrangements have been made for a short course of instruction in the production and handling of milk, to be held at the College from 31st January to 24th February, 1923. Particulars of the course, which will be conducted on the same lines as the courses in Clean Milk Production held in February last and in 1921, are shown in the syllabus outlined below:—

Syllabus of the Course.—The instruction will consist of lectures, laboratory work, demonstrations, and visits to well-known dairy establishments. The course is intended primarily for instructors in dairying, but other applicants will be admitted so far as accommodation allows. It is essential, however, that all applicants for admission shall have had some systematic training in dairying and the sciences related thereto.

The tuition fee for the course is £5, which does not include the necessary travelling expenses in connection with the excursions. As the course will be held during term it will be impossible to offer accommodation in a Hall of Residence, but the College will supply a list of addresses where suitable rooms can probably be found.

Students should travel to Reading before 31st January, in order to be able to commence the course promptly.

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REPLIES TO CORRESPONDENTS.

Sugar Beet.—A.B. asks for the name and address of firms who manufacture sugar from sugar-beet.

Reply: The only factory now engaged in manufacturing sugar from sugar-beet in this country is that at Cantley, Norfolk.

Basic Slag.—C.D. proposes to give a paddock on which pigs and poultry are run a dressing of basic slag, and asks whether either will take any harm from this.

Reply : Though no evidence is available that poultry suffer any ill-effects from being put on to newly slagged pasture, it would be advisable both with poultry and with other livestock to wait, as recommended in Leaflet No. 267, until a heavy shower has washed most of the slag off the herbage.

Manurial Value of Goose Droppings.—E.F. has found that geese keep a lawn cropped very closely and that a luxuriant crop springs up afterwards. He asks whether cattle would eat grass after geese had been on it, and whether geese would do good on a meadow kept for hay.

Reply : A copy of Leaflet No. 198, which refers to grazing geese, was sent to the correspondent, who was informed that as regards the alleged destruction of herbage, this will generally be avoided when only a limited number of geese are allowed to graze on a given spot, especially if by means of hurdles or otherwise they can be moved from one part to another of the ground. In that case they are likely to be more beneficial than otherwise. Reference was also made to the article in this *Journal* for March, 1907, on Poultry Manure.

Meadow Saffron.—G.H. asked whether it is true that the autumn flowers do not poison while the spring flowers do.

Reply . A copy of Leaflet No. 222 was sent and correspondent informed that Meadow Saffron (*Colchicum antumnale*, L.) does not flower in the spring, but in the autumn. Possibly confusion has arisen owing to the fact that there are non-poisonous species of crocus which are called saffron (e.g. *Crocus aureus*, Sibth.—spring flowering, and *Crocus sativus*, L.—autumn flowering.)

Fallows and Bastard Fallows.—J.K. writing from Cumberland asks for information as to fallows and bastard fallows.

Reply : Leaflet No. 172, which deals with bare fallows, was sent and the following information added:—"For fallowing spells of dry weather are essential and it is consequently better adapted to the south than the north. To be successful fallows must be worked at the right time and the 'right time' generally clashes with hay-time or harvest or other busy season."

Stoats in a Poultry Yard.—L.M. suspect stoats of depredations in a poultry yard.

Reply : "Stoats, martins, &c., may be killed with strychnine-poisoned eggs. The following directions should be observed :—

> Carefully remove with a very sharp knife a small piece of the shell, insert *1 grain* of strychnine, replace the removed fragment of shell using a little of the egg albumen for the purpose. The operation should be carried out skilfully to allay the stoat's suspicion.
>
> Before using the poisoned eggs try to get the stoat's appetite attracted by placing unpoisoned eggs for a few nights at his disposal. When he takes these, miss a night and let him have the prepared ones.

Ordinary poisons are of no use as the stoat kills for the lust of blood, simply sucking the bodies of its victims dry.

In using strychnine-poisoned eggs the *greatest* care in the preparation and application of same is essential. The chickens should be kept, if only temporarily, in stoat-proof pens."

Manurial Value of Feeding Stuffs.—N.O. asks how to calculate the manurial value of feeding stuffs.

Reply : "A rough method of calculating the manurial value of feeding stuffs is given on page 11 (1922 edition) of the Ministry's Miscellaneous Publication No. 32 on *Rations for Live Stock.*

Where the content in nitrogen (N), phosphoric acid (P_2O_5) and potash (K_2O) of any given feeding stuff is known the method adopted by Hall and Voelcker (see *Journal of the Royal Agricultural Society*, Vol. 74, 1913, p. 104) is usually employed. By this method in calculating manurial value, allowance is made for half the nitrogen and three-quarters each of the phosphoric acid potash.

The unit values assigned for these three constituents vary with the prices of artificial manures. They are given week by week in the "Agricultural Market Report" published by the Ministry,* except for insoluble phosphates. The method of working out the unit value of insoluble phosphate is explained in the Ministry's Leaflet No. 72, which also gives the rules for converting phosphate into phosphoric acid."

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Allotments Advisory Committee.—In accordance with the recommendation of the Departmental Committee on Allotments, the Minister of Agriculture and Fisheries has appointed a Committee to advise the Ministry on matters affecting allotments in England and Wales. The constitution of the Committee is as follows:—

The Rt. Hon. the Earl of Ancaster, Parliamentary Secretary to the Ministry. (Chairman).

The Rt. Hon. the Earl Stanhope, representing the Central Landowners Association.

Sir Kingsley Wood, M.P., representing the Parliamentary Allotments Committee.

Francis Dent, Esq., representing the County Councils' Association.

H. A. Learoyd, Esq., Town Clerk of Hull, representing the Association of Municipal Corporations.

Reginald C. Graves, Esq., LL.B., Clerk and Solicitor to the Tottenham Urban District Council, representing the Urban District Councils' Association.

C. Crofton Black, Esq., Barrister-at-Law, representing the Land Union.

The Rt. Hon. F. D. Acland,
George Nicholls, Esq., O.B.E.,
Walter West, Esq., } representing the Agricultural Organization Society.

Robert Norman, Esq.,
Alderman H. Berry,
J. Forbes, Esq., } representing the National Union of Allotment Holders.

The Secretary of the Committee is Mr. E. Lawrence Mitchell, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W. 1.

The London Thoroughbred Stallion Show for 1923.—The Ministry (acting on behalf of the War Office) gives notice that a Show of Thoroughbred Stallions will be held, in conjunction with the Hunters' Improvement and National Light Horse Breeding Society, at the Roya Agricultural Hall, Islington, on 27th and 28th February and 1st March, 1923.

A Challenge Cup, presented by H.M. the King, will be awarded for the Champion Stallion in the Show; and a Gold Medal will be awarded by the Ministry to the owner. Sixty King's Premiums (including 12 Super-Premiums) will also be offered for award by the Ministry.

In addition to the King's Premiums, a very limited number of Ministry's Premiums will be available for award on the recommendation of the County

* Also monthly in this *Journal*.

Horse Breeding Committees. These awards will not be made, however, until the routes of the King's Premium stallions have been arranged.

Copies of the Regulations governing the award of the Premiums can be had on application to the Ministry after 11th December.

Export of Dogs to the Channel Islands.—The Ministry is advised that the restrictions as to the importation of dogs into the Channel Islands from Great Britain referred to in the August issue of the *Journal* have now deen withdrawn. Accordingly, no certificate issued by the Ministry or other document is necessary in this connection.

The regulations concerning dogs imported into the Islands from countries abroad, as stated in the August issue of the *Journal*, are still in force.

West Surrey Goat Club.—The following note has been received from Mrs. Epps of the West Surrey Goat Club :—The West Surrey Goat Club is one of the many county goat clubs that have arisen since the war. It was founded in 1919 by a small Committee which had organised the first Guildford goat show, and from the time of its inception to the present date it has steadily extended the scope of its activities. The management of the Club is vested in a Committee of twelve members ; the membership is about 200, more than half of these being of the cottage class. The difficulty of dealing by correspondence with cottage stock-keepers is well known, and the Club has found that a system of local supervisors is readily workable. Membership is quite open, and the subscription for ordinary members is 6s. and for cottage members 1s. 6d. The funds are devoted to promoting village shows, issuing a quarterly leaflet to members and placing good billies at stud at moderate fees.

The Club has recently purchased a fine Toggenburg male imported by the British Goat Society, and this animal is now available for service, Club members getting very advantageous terms.

A large open show is held at Guildford annually, but the Club finds its best recruiting ground at the village shows, for here the cottagers are glad to bring their goats to compete against their neighbours without the trouble and heavy expense of a rail or road journey and the loss of the day's milk.

The Club offers every encouragement to the many people who find difficulty in getting an adequate supply of cows' milk but are able to maintain one or two goats. This class of goat-keeper is not in a position to maintain a good stud goat, and the Club endeavours to provide good billies throughout the county to supplant the third-rate animals that are too frequently used.

Another matter of importance that the Committee is interested in is that of the milk yields of the ordinary goat. At present the only figures available deal with exceptional exhibition animals, but if figures could be obtained as to the yield over a lactation period of the usual type of goat kept in the county, the information would be of considerable value. A few herds are recorded under the milk recording schemes devised for dairy herds, but the cost of this is prohibitive to the small goat-keeper.

Foot-and-Mouth Disease.—No futher outbreaks having occurred in the Woodstock (Oxon) or Surrey districts, all restrictions on the movement of animals in these districts were removed on 4th and 15th December respectively.

On 29th November, an outbreak of foot-and-mouth disease was confirmed on premises at Huntingdon, near Chester, which necessitated the application of restrictions to the usual area of 15 miles radius from the infected place.

Further outbreaks occurred on 1st December at Handley (5 miles distant), on 6th December at Whitby, near Birkenhead, and on 12th December at Tattenhall, in the vicinity of the original outbreak. The restrictions in the outer portion of the prohibited area have been modified, but the size of the area had not been reduced up to 18th December, the date to which the information contained in this note is carried.

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QUESTIONS IN PARLIAMENT.

Telephones in Rural Areas.— In reply to a question in the House of Commons by Mr. Millar on 30th November as to the terms on which new telephone exchanges are now being opened in rural areas and the present tariff and rates for rural party lines, the Postmaster-General, Mr. Neville Chamberlain, said : " New exchanges are being provided in rural areas at an installation rental of £2 a quarter per circuit, within a mile of the exchange, provided that at least eight subscribers are forthcoming and the cost of the line required to connect the new exchange with the existing system is not abnormally high. If 15 subscribers can be found the normal tariff charges apply. These terms cover a day service only, but it is often possible by a party line arrangement to extend the suoscribers' circuits at night to an exchange open always, subject to a payment of 5s. a quarter. Two-party lines are offered at lower rates than the exclusive service charges to those who live more than a mile from an exchange. Rural party lines are provided at a charge of £1 or £1 2s. 6d. a quarter per station where three or two subscribers respectively per mile of line beyond a radius of half a mile from the exchange can be found. Rural party line rentals cover an unlimited number of calls to subscribers on the same exchange."

Importation of Irish Store Cattle.—The following summary of the conditions on which Irish store cattle may now be imported was given by the Minister for Agriculture in the House of Commons on 5th December in answer to a question by Lt.-Col. Murray : —" Store cattle brought from Ireland to Great Britain are required to be landed only at approved landing places, where each cargo has to be detained for at least 10 hours for rest and examination by veterinary inspectors of the Ministry. All cattle must be marked before landing. No cattle may be removed from the landing place except with a licence of the Ministry's inspector, and then only to

(*a*) A market or part of a market authorised by the local authority for the sale of Irish animals, from which they can only be moved by licence of the local authority's inspector to private premises for six days' detention ; or

(*b*) private premises, *i.e.*, any premises other than a market, fair-ground or sale yard, where the cattle must be detained for six days.

Provision is made for the slaughter of any of the animals during the period of detention, if required. To facilitate marketing, the cattle may *en route* from the landing place to the market, be temporarily kept in authorised lairs or enclosures under the control of the local authority for a period not exceeding 72 hours whilst awaiting exposure for sale.

NOTICES OF BOOKS.

The Agricultural Note Book.—(Primrose McConnell, B.Sc. Tenth Edition. London: Crosby, Lockwood & Son, 1922. 15s. net.) The first edition of this work was published in 1883 and the ninth edition in 1919. It is so well known as a work of reference, that probably few who are engaged in agriculture are unfamiliar with it. It deserves as a motto a Latin distich prefixed to a sixteenth century volume, itself not wholly unconnected with agriculture, to the effect that the writer who gets much within the limits of a compact volume deserves as much credit as the speaker who adequately deals with a wide subject in few words. The latest edition is in form as concise and handy as the earlier. But numerous alterations are apparent. The costs of labour have been revised and compensation values of feeding stuffs have been re-adjusted. The figures assigned, however, are in the light of present times, distinctly on the high side and will need correcting periodically. Current manurial values for most feeding stuffs will, it may be noted, be found in the Monthly Notes published in this *Journal*. A new paragraph on vitamines brings information on this question up to date. Practically every third or fourth page shows traces of revision. While everybody who has to deal with farming should already possess this book, those who have been remiss are penalised slightly by the unavoidably enhanced post-war price, while they reap the unmerited reward of being provided with an edition even more useful than its very useful predecessors.

The Feeding of Dairy Cattle.—(Andrew C. McCandlish, M.S.A., Professor of Dairy Husbandry, Iowa State College, U.S.A. 8vo., 281 pp., 15 illustrations. London: Chapman & Hall, Ltd., 1922. Price 12/6 net.) This handy little volume deals in simple, non-technical language with the importance of the Dairy Cow as an economic factor in husbandry. First of all the main principles of nutrition are briefly reviewed after which the problems of practical feeding are discussed.

The Dairy Cow is looked upon as the market for home-grown foodstuffs in respect of which the Dairy Farm should be self supporting. The Author points out that as a rule, only concentrates of high protein contents need be purchased and indicates the chief considerations which should govern their choice. A useful table is included showing how to arrive at the relative cost of digestible crude protein in the commoner feeding stuffs.

Short chapters are devoted to Calf-rearing and to digestive disturbances among stock.

Analyses and Energy Values of Foods.—(R. H. A. Plimmer, D.Sc. London: H. M. Stationery Office, Imperial House, Kingsway, W.C.2.) This book is a useful compendium of analyses and energy values of foods in common use in this country, and should prove of value to all interested in dietetics.

The aim of the author has been to arrive at an average for each group of foodstuffs, such as beef from analyses of the various joints, bread from the produce of various bakeries, fish from the group of white fish, etc. In the case of meat the joints were separated into fat, skin, lean, and so forth, and the proportions determined so as to calculate the whole. Further, the

proportions of the joints of the carcass have been ascertained so that the composition of any part and ultimately of the whole animal can be arrived at. The analyses number about 900, and the data recorded include most of the common foods such as meat, poultry and game, cheese, bacon, ham and pork, tinned meats, eggs fresh and dried, fish, fruit, nuts and vegetables. The book contains the analytical data necessary for the construction of dietaries for human use, and is worthy of study by all whose duties include the supervision and designing of dietaries for use in schools and other institutions.

Cyclopedia of Farm Animals and Cyclopedia of Farm Crops.—(L. H. Bailey. London: Macmillan & Company Ltd. Price 25/- nett each.) These two volumes, each containing about 700 pages of well printed and well illustrated matter, are re-issued from the Cyclopedia of American Agriculture, which is now out of print. The arrangement of both volumes follows the Cæsarean division into three parts, the first part dealing generally with physiology, breeding, diseases and management, the second with the manufacture of products—(i) dairy and meat products, and (ii) fruit and vegetable preserving, brewing, etc.—while the third part deals in alphabetical sequence with farm animals and crops respectively. Although written from the American standpoint, these volumes should prove a most useful and comprehensive work of reference for farmers and students in other countries.

Sturtevant's Notes on Edible Plants.—(U. P. Hedrick. Albany, U.S.A.: J. B. Lyon Company.) This interesting and valuable compilation issued under the editorship of Dr. U. P. Hedrick, Horticulturist to the New York Agricultural Experiment Station, is based on material collected by the late Dr. E. Lewis Sturtevant, who was Director of the Station from 1882 to 1887. Geographical and historical details are given of the distribution, variations and uses of nearly 3,000 edible plants, arranged in alphabetical order according to genera (following the nomenclature of the Kew Index), species being given alphabetically under each genus, followed by English vernacular names as used in the standard botanical text-books. The volume, which represents the results of long and extended research in botanical literature, is enriched by a copious bibliography and index and is handsomely printed and bound.

Les Insectes et leurs Degats.—(E. Douge et P. Estiot (Encyclopédie Pratique du Naturaliste.) Paris: Paul Lechevalier. Price 15 francs.) This is a pocket size book of 244 pages, the first half of which is devoted to a general exposition of the organisation, development, classification and habits of insects, followed by a chapter containing directions for the preparation and application of insecticides. The second half consists of detailed notices with coloured plates, of the insects most frequently attacking culinary plants, fruit and forest trees, field crops, flowers and ornamental plants.

Les Champignons comestibles et vénéneux.—(A. Maublanc (Encyclopédie Practique du Naturaliste.) Paris: Paul Lechevalier. Price 15 francs.) A companion volume to the entomological work noted above, the first half dealing generally with fungi and their classification, the second consisting of coloured plates, with explanatory notes, illustrating the most important edible and poisonous mushrooms and toadstools.

La Destruction des Mauvaises Herbes.—(E. Rebaté. Paris: Librairie Agricole de la Maison Rustique. Price 4.50 francs.) Any information which will aid us to combat weeds will always be useful, and the little

book by Rabaté is intended to be so. It opens with a brief discussion as to the damage done by weeds, their classification, increase, and accumulation of thier seeds in the soil. It next proceeds to discuss preventive and remedial measures such as may be used by farmers, and briefly touches on French administrative measures designed to reduce weeds. Destruction of weeds by chemical means is dealt with at some length (82 pages) the substances covered being mineral acids, caustic soda, caustic potash, sulphate of zinc, sulphate of ammonia, nitrate of soda, sea salt, calcium chloride, kainit, arsenite of soda, cyanamide, crude ammonia, calcium sulphide, various organic and other chemical substances, sulphates of iron and copper, nitrate of copper, bisulphate of soda, and sulphuric acid. The last 43 pages are devoted to a consideration of various weeds of cornfields, and of grass land.

Diseases of the Small Domestic Animals.—(O. V. Brumley, V.S. London : Baillière, Tindall and Cox. Price 21/- nett.) This volume is a classified dictionary of most of the important diseases (medical and surgical) of small animals with which the veterinarian comes into contact. Under the headings "Diseases of the Respiratory System . . . Circulatory System . . . Digestive Tract . . . Skin, Ear, Eye, etc.," information is given as to causes, symptoms and treatment. The four chapters comprising the last section deal with infectious diseases, including fowl cholera, fowl pest, anthrax, foot-and-mouth disease, rabies and glanders. The work should be useful to the student and the busy practitioner for whom it is primarily intended.

Principles and Practice of Butter-Making.—(By G. L. McKay, D.Sc., Secretary American Association of Creamery Butter Manufacturers, formerly Professor of Dairying in the Iowa State College, Ames, Ia., and C. Larsen, M.S.A., Professor of Dairy Husbandry, So. Dak State College, Brookings S.D., formerly Associate Professor Iowa College, Ames, Ia. Third edition largely rewritten. London : Chapman & Hall, Ltd. Price 15/- net.)

The third edition of this valuable publication shows evidence of a very careful revision. In addition to a very complete account of the technical process of butter on the most approved lines, it contains a considerable amount of other useful information on such subjects as the properties of milk, the food value of milk, ferments in milk, abnormal milk, variation in the fat of milk, the sampling, grading and testing of milk, composite samples, creamery calculations, separation of cream, pasteurisation, refrigeration, creamery economics, etc. It can be recommended as a safe guide to Dairy Factory Managers, and is a book which all dairy students would do well to consult.

From Crow-Scaring to Westminster: An Autobiography.—(George Edwards, M.P., O.B.E. 240 pp., 5 illustrations. London : The Labour Publishing Co., Ltd., price 5/-.) Born in a family on the verge of starvation, himself starting farm work at the age of 6, unable to read until taught by his devoted wife in brief evenings after arduous daily toil and eventually rising to represent his native county in Parliament, Mr. George Edwards is indeed, as Lord Ailwyn says in a foreword to his Autobiography, a notable example of the way in which adverse circumstances may be overcome by determination and natural ability. Devoted as his life has been to the betterment of the lot of his fellow agricultural workers, his story is largely that of the conception and development of a spirit of class consciousness and organisation among them. Not only, however, does the author give a frank account of the struggles and disappointments of his organising activities but his pages afford many a valuable glimpse into the actual conditions of living amongst agricultural workers in the early Victorian era. This famous pioneer of the agricultural workers' cause, who is now the honoured veteran respected by all parties, concludes on a note which will appeal to all concerned in the present difficult times : "let the spirit of moderation and goodwill dwell amongst you."

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

Rew, Sir R. Henry.—The Story of the Agricultural Club, 1918—1921. (205 pp.) London: P. S. King & Son, Ltd., 1922, 10s. 6d. net. [331(b); 338.1(02); 63(062).]

Development Commission.—Industries in Rural Districts, by *E. C. Kny.* (25 pp.) 1921. [63.193.]

McConnell, Primrose.—Notebook of Agricultural Facts and Figures for Farmers and Farm Students. [Tenth Edn., rev. and enl.] (549 pp.) London: Crosby, Lockwood & Son, 1922, 15s. net. [63(03).]

The Faraday Society.—Physico-Chemical Problems Relating to the Soil: A General Discussion held at the Society. [Reprint from the Transactions of the Society, vol. xvii, pp. 218-368.] London, 1922, 10s. 6d. [63.112; 63.113.]

West of Scotland Agricultural College.—Bull. 101:—Rotation Cropping on a Demonstration Area in Wigtownshire. (24 pp.) Glasgow, 1922. [63.191.]

Canada Department of Agriculture.—Bull. 8 (New Series):—Fertilisers for Field Crops: their Nature, Functions and Application, with Results from recent Experiments in Canada. (64 pp.) Ottawa, 1922. [63.16(04).]

Fournier, L.—Les Stimulants Radio-Actifs en Agriculture: leur Rôle dans les Engrais. (73 pp.) Paris: Librairie de l'Institut National Agronomique, 1922, 3fr. 75. [537; 63.168.]

Cornell Agricultural Experiment Station.—Bull. 406:—Decomposition of Green Manures at Different Stages of Growth. (pp. 139-169.) Ithaca, 1921. [63.165.]

Scott, A., and *M'Arthur, D. N.*—The Constitution of Basic Slag. (Reprinted from the Journal of the West of Scotland Iron and Steel Institute, session 1921-22. pp. 80-102.) Glasgow, 1922. [63.1672.]

Garola, C. V.—Engrais: I. Les Matières Fertilisantes. (348 pp.) Paris: J. B. Baillière et Fils, 1921, 10fr. [63.16(02).]

Garola, C. V.—Engrais: II. La Pratique de la Fumure (356 pp.). Paris: J. B. Baillière et Fils, 1921, 10fr. [63.1625.]

[These two volumes form an up-to-date revision of the text book by this eminent French authority. The extended form allows of greater detail being devoted to the technique of manuring, and a review of the regulations governing the sale of manures in France is included.]

Institut International d'Agriculture.—Ramassage et Utilisation des Déchets et Résidus pour l'Alimentation de l'Homme et des Animaux, pour les Engrais et les Industries Agricoles (1914—20). (336 pp.) Rome, 1922, 20fr. [58.16; 63.16(02); 63.163; 63.165; 63.604(a).]

Rabaté, E.—La Destruction des Mauvaises Herbes. (164 pp.) Paris: Librairie Agricole de la Maison Rustique, 1922, 4fr. 50. [63.259(02).]

Maublanc, A.—Les Champignons comestibles et vénéneux de France. (110 pp. et 86 planches coloriées.) Encyclopédie Pratique du Naturaliste. vol. viii. Paris: P. Lechevalier, 1921, 15fr. [63.24(02).]

Grey, Edwin.—Rothamsted Experimental Station: Reminiscences, Tales and Anecdotes of the Laboratories, Staff and Experimental Fields, 1872-1922. (155 pp.) Harpenden: Rothamsted Experimental Station, 1922, 5s. [37(072).]

[Many to whom the scientific achievements of the Rothamsted Experimental Station are well known will find a lightsome human charm in the personal record of Mr. Grey, the genial "Field Superintendent," whose association with the Station, dating from 1872 when as a boy he went to work as a grass picker on the experimental plots, has brought him into intimate contact with all ranks of his fellow-workers, from the famous founders, Lawes and Gilbert, to the present Director, Sir John Russell, who contributes an introduction to the book.]

National Institute of Agricultural Botany.—4th Annual Report of the Official Seed Testing Station, August, 1920 to July, 1921 (14 pp.) Cambridge, 1922, 1s. 6d. [63.1951.]

Buchanan, R. E.—Agricultural and Industrial Bacteriology. (468 pp.) New York and London: D. Appleton & Co., 1921, 15s. net. [576.8(02).]
[A general survey of bacteriological topics of interest to farmers and others employed in trades allied to farming and farm produce.]

Rasor, S. E.—Mathematics for Students of Agriculture. (290 pp.) New York: The Macmillan Co., 1921, 16s. net. [51(02).]

Peat's.—Farmer's Diary and Account Book: A Complete and Easy Method of Keeping Farm Accounts. (104 pp.) London: Simpkin, Marshall, Hamilton, Kent & Co., 1922, 3s. [657.]

Kirkwood, John.—Farm Book-Keeping. The Principles and Practice of Book-Keeping applied to Agriculture for Agricultural Colleges, Extension Classes, Evening Classes and Practical Farmers. (224 pp.) Edinburgh: W. Green & Son, Ltd., 1922, 6s. net. [657(02).]
[One of the Scottish Series of Junior Agricultural Text Books prepared under the competent editorship of Professor Hendrick, of Aberdeen University. Like the other books of this series, it is written with a special view to the agricultural conditions of Scotland and the north of England, though at the same time it is justifiably hoped that it may occasionally be found useful and acceptable south of the border. The greater part of the book is devoted to a study of a Double Entry System, but a simple form of cash-book is added for the benefit of farmers who have not the time or opportunity to adopt the fuller method. Exercises are given in the different sections and an appendix gives the papers set in National Diploma examinations of 1921 and 1922.]

Field Crops.

University of Leeds and Yorkshire Council for Agricultural Education.—No. 123:—Report on Experiments with Wheat at Manor Farm, Garforth, and in the North Riding, 1921 (19 pp.). Leeds, 1922. [63.311(04).]

University College of Wales, Aberystwyth, Welsh Plant Breeding Station.—Series C, No. 2:—Varieties of Oats in Cultivation. (44 pp. and Plates.) Aberystwyth, 1922, 5s. 6d. [63.314(04).]

U.S. Department of Agriculture.—Bull. 1058:—Sterility of Oats. (8 pp.) Washington, 1922. [63.21.]

Australia. Institute of Science and Industry.—Bull. 22:—A Classification and Detailed Description of the Barleys of Australia. Being the 2nd Report of the Special Committee on Seed Improvement. (33 pp.) Melbourne, 1922. [63.313(04).]

Midland Agricultural and Dairy College.—Trials with Cereal Crops at the College (Lodge) Farm, 1919—21:—(*a*) Nitrogenous Top Dressings for Wheat. (*b*) Ammonium Chloride *v.* Ammonium Sulphate for Oats. (*c*) Rates for Seeding Wheat. (8 pp.) Kingston, 1922. [63.31(04).]

Olympia Agricultural Co., Ltd., Research Department.—Bull. 2:—Field Tests with Cereals. Seasons 1920—21. (16 pp.) Offchurch Bury, 1922. [63.31(04).]

Olympia Agricultural Co., Ltd., Research Department.—Bull. 1:—Field Experiments with Potatoes, 1920 and 1921. (18 pp.) Offchurch Bury, 1922. [63.512(04).]

Midland Agricultural and Dairy College.—Varieties and Manuring of Potatoes: Results of Trials on the College Farm, 1920—21. (14 pp.) Kingston, 1922. [63.512-16.]

University College of North Wales, Bangor, Department of Agriculture.—Formation of Permanent Pastures. Relation between the Seeds Mixture and the Herbage on the 6 or 7 year old Pastures. (14 pp.) Bangor, 1922. [63.33(*a*).]

University College of Wales, Aberystwyth, Welsh Plant Breeding Station.—Series H, No. 1, Seasons 1919—21. Preliminary Investigations with Herbage Plants. (97 pp.) Aberystwyth, 1922, 3s. 6d. [63.1952; 63.33(04).]

University College of North Wales, Bangor, Department of Agriculture.—Report on Experiments on Growth of Green Crops on Arable Land for Dairy Cows, 1920-1921. (61 pp.) Bangor, 1922. [63.33(04).]

University College of North Wales, Bangor, Department of Agriculture.—1920 and 1921 Reports on Formation of Permanent Pastures. (12 pp.) Bangor, 1922. [63.33(*a*).]

Ontario Department of Agriculture.—Bull. 287 :—Silos and Silage. (32 pp.) Toronto, 1922. [694; 63.1985.]

Bailey, L. H. (Edit.).—Cyclopedia of Farm Crops. (699 pp.) New York and London : Macmillan Co., 1922, 25s. net. [63.3(02).]

The Chilean Nitrate Committee.—Catch Crops and Forage Crops. (40 pp.) London, 1922. [63.33(04).]

Cornell Agricultural Experiment Station.—Memoir 46 :—A Classification of the Cultivated Varieties of Barley. (pp. 369-456.) Ithaca, 1921. [63.313.]

Horticulture and Fruit Growing.

Fletcher, F. J.—Orchard Fruit Tree Culture. [Market Nursery Work Series, vol. v.] (71 pp.) London : Benn Bros., Ltd., 1922, 4s 6d. net. [63.41(02).]

[One volume of a series of six which aim at placing in the hands of practical nurserymen concise and up-to-date information concerning the scientific development of their work. The present volume deals fully with the planting, budding, grafting and pruning of orchard fruit trees, together with a chapter on the marketing of produce.]

Departmental Committee on Allotments.—Report of the Departmental Committee appointed by the Minister of Agriculture and Fisheries and the Secretary for Scotland to investigate the present position as regards the Provision by Local Authorities of Allotments in Great Britain. (32 pp.) London : H.M. Stationery Office, 1922, 6d. net. [63.5(08).]

Davidson, H. C.—Vegetable Culture : A Practical Manual. (144 pp.) London : Crosby, Lockwood & Son, 1922, 4s. 6d. net. [63.511(02).]

[A useful manual containing cultural directions for the ordinary garden-grown vegetables, which are dealt with in alphabetical order. Notes on pests and diseases are added under each crop dealt with, and a calendar indicating the dates for the various operations is given at the end.]

Davidson, H. C.—The Culture of Pot-Plants in Rooms, Greenhouses, and Frames. (153 pp.) London : Crosby, Lockwood & Son, 1922, 5s. net. [63.52.]

[A companion book to the author's manual on Vegetable Culture noticed above. Following two chapters of general directions for the management of plants in rooms, greenhouses and frames, the arrangement is in groups of plants according to the purposes for which they are grown, e.g., "Winter flowering plants," "Plants grown for their scent," &c. An index is added.]

Cruess, W. V., and *Christie, A. W.*—Laboratory Manual of Fruit and Vegetable Products. (109 pp.) New York and London : McGraw-Hill Book Co., Inc., 1922, 7s. 6d. [664.84; 664.85.]

[This manual, which is the outcome of a course given at the University of California during the last eleven years, is intended primarily for use in agricultural colleges and domestic science schools, but it contains much information which should be of value to growers, manufacturers and others interested in the preservation of fruit and vegetable products by canning, drying, &c The volume is admirably printed and bound.]

Plant Diseases.

University College of North Wales, Bangor, Department of Agriculture.—Experiments with Plant Diseases :
(*a*) Finger and Toe in Swedes and Turnips.
(*b*) Leaf Curl in Potatoes.
(12 pp.) Bangor, 1922. [63.24; 63.24-33.]

California Agricultural Experiment Station.—Bull. 336 :—The Preparation of Nicotine Dust as an Insecticide. (262-274 pp.) Berkley, 1921. [63.295.]

U.S. Department of Agriculture.—Farmer's Bull. 1260 :—Stored-Grain Pests. (47 pp.) Washington, 1922. [63.27-31.]

[One of the informative bulletins issued by the American Department of Agriculture dealing briefly and in popular style with a considerable number of pests affecting grain. A short account of preventive methods is also included.]

Smith, K. M., and *Gardner, J. C. M.*—Insect Pests of the Horticulturist: Their Nature and Control. Vol. i: Onion, Carrot and Celery Flies. (76 pp.) London: Benn Bros., Ltd., 1922, 7s. 6d. net. [63.27-51.]

Sanders, T. W.—Vegetable Foes: A Description of the various Insect, Animal and Fungal Pests that attack Vegetable Crops, with Remedies for their Prevention and Eradication. (109 pp.) London: W. H. & L. Collingridge, 1922, 4s. net. [63.24-51; 63.27-51.]

[Commencing with the Asparagus Beetle and ending with the Turnip Gall Weevil, this book deals briefly with the life histories of the various pests and diseases known to be injurious to vegetable food crops, following the alphabetical order of the crop attacked and indicating the remedies under each. Recipes are given for the preparation of insecticides and fungicides, and a final chapter deals with different methods for the sterilisation of soils.]

Dongé, E., et *Estiot, P.*—Les Insectes et leurs Dégats. (115 pp. et 100 Planches coloriées.) [Encyclopédie Pratique du Naturaliste. vol. vi.] Paris: P. Lechevalier, 1921, 15fr. [63.27(02).]

Live Stock.

Kansas Agricultural Experiment Station.—Circular 86:—Cattle Feeding Investigations, 1919-20. (11 pp.) Manhattan, 1921. [63.625.]

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[Mr. Orr has succeeded in presenting a readable record of the salient landmarks from the earliest times to the repeal of the Corn Production Act in June, 1921. The book is ornamented with numerous illustrations reproduced from various sources and is turned out in a manner worthy of the Oxford University Press. The absence of an index or a table of contents, though a drawback, can hardly be accounted a serious fault in a summary of such small dimensions.]

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Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE,
By Metchim & Son, Princes Street, Westminster, S.W. 1.

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXIX. No. 11.

FEBRUARY 1923.

NOTES FOR THE MONTH.

Agricultural Tribunal of Investigation.

THE Tribunal of Investigation appointed by the Prime Minister to inquire into the agricultural problem, to which reference was made in the January issue of the *Journal*, consists of the following economists:—Sir William Ashley, Professor of Commerce and Vice-Principal of the University of Birmingham; Professor W. G. S. Adams, Gladstone Professor of Political Theory and Institutions, Oxford; and Professor D. H. MacGregor, Drummond Professor of Political Economy, Oxford.

Mr. C. S. Orwin, Director of the Institute for Research in Agricultural Economics at Oxford, has been appointed Agricultural Assessor to the Tribunal, and Mr. D. B. Toye, of the Ministry of Agriculture and Fisheries, will act as Secretary.

The Tribunal has now held thirteen meetings at which agricultural conditions, both in Great Britain and in other countries, have been investigated and discussed. In addition, the Tribunal has received evidence from several witnesses.

* * * * * *

Committee on the Distribution and Prices of Agricultural Produce.

THE Departmental Committee on the Prices and Distribution of Agricultural Produce, under the Chairmanship of the Marquess of Linlithgow, has made rapid strides during the month of January in the direction of hearing evidence. So far, the Committee has provisionally heard witnesses regarding milk, fruit and vegetables, and meat, but the evidence is by no means complete in respect of any of these commodities. The Committee is now concentrating its efforts upon milk, and it is anticipated that it

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will be fully occupied with hearing the remaining evidence in connection with this branch of the inquiry until Parliament reassembles. It is understood that the Committee then proposes to issue an interim report dealing with milk alone, after which it will proceed, in the same way, to issue separate reports in respect of fruit and vegetables, meat, cereals, and bread.

Inquiries are necessarily prolonged in a subject so complex and difficult as that with which the Committee has been appointed to deal. A considerable number of trade organisations and other representative bodies have to be heard in respect of each commodity. As regards milk, for instance, evidence has already been received from such organisations as The British Dairy Farmers' Association, the Agricultural Organisation Society, the National Farmers' Union, the London and Provincial Master Dairymen's Association, the National Society of Creamery Proprietors and Wholesale Dairymen, the National Citizens' Union, United Dairies Limited, and from Nestlé's Milk Company, as well as from the wholesale and retail branches of the co-operative movement, and before the inquiry as regards milk is brought to a close, it will be necessary to hear evidence from many other organisations, including those representing Scotland.

* * * * * *

Eradication of Glanders in Great Britain.

IN the Report of the Chief Veterinary Officer for 1921 is recorded one of the outstanding successes in the operations of the Ministry in the treatment of animal diseases under the Diseases of Animals Acts. This is the almost entire suppression of the disease known as Glanders or Farcy. Glanders is a serious disease in this country, usually confined to horses, asses and mules. It is generally fatal, and, as veterinarians and medical men know, the more to be feared because of the possibility that human beings may contract it by infection from an equine. It is also difficult of diagnosis in its early stages.

The Glanders or Farcy Order of 1920 requires all animals affected with the disease to be slaughtered and compensation for their loss paid to the owner. Before the passing of the Glanders Order of 1907, only horses showing clinical symptoms of the disease were slaughtered. That Order, however, laid down as an additional basis for diagnosis, the mallein test, and Local Authorities were empowered to apply that test

to any suspected horse, ass or mule. They were required to slaughter all animals reacting to the test, as well as all animals showing clinical symptoms of the disease. The reduction in the number of outbreaks year by year since the Order of 1907 came into force (1st January, 1908) affords striking proof of its efficacy. In 1907 there had been no fewer than 854 outbreaks of the disease, affecting 1,921 animals in Great Britain. In 1922, only 4 outbreaks were recorded for the year.

The Ministry has now issued a Circular Letter to all Local Authorities who are empowered to deal with animal diseases, stating that the Ministry is satisfied that Glanders has now been almost entirely eradicated from the country. In order, however, that the Ministry shall be enabled to announce the freedom of the country from the disease with greater confidence when the proper time arrives, it is desired that Local Authorities should furnish the fullest and most accurate information in regard to all future outbreaks, including the supply of specimens of the affected organs for expert examination at the Ministry's Veterinary Laboratory.

* * * * * *

The Agricultural Index Number.

THE index numbers of the prices of agricultural produce in England and Wales show that, on the whole, average prices were relatively lower during December than in the previous month, the average increase compared with the corresponding month in the years 1911 to 1913 being 59 per cent. in December against 62 per cent. in November. The percentage increase in each month since the beginning of 1920 is shown in the following table:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911-13.

MONTH.	1920.	1921.	1922.
January	200	183	75
February	195	167	79
March	189	150	77
April	202	149	70
May	180	119	71
June	175	112	68
July	186	112	72
August	193	131	67
September	202	116	57
October	194	86	59
November	193	79	62
December	184	76	59

The following table shows the average increases during recent months in the values of the principal commodities:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

Commodity.	1922					1921.
	Aug.	Sept.	Oct.	Nov.	Dec.	Dec.
Wheat ...	53	23	24	32	32	45
Barley ...	48	26	29	34	17	56
Oats	59	31	33	38	36	45
Fat cattle ...	70	58	49	48	48	61
Fat sheep ...	103	90	90	87	81	44
Fat pigs ..	92	84	85	94	94	62
Dairy cows ...	67	63	69	74	72	95
Store cattle ...	42	33	30	29	28	39
Store sheep ...	114	109	106	93	83	43
Store pigs ...	128	125	135	148	151	75
Eggs... ...	64	96	104	98	63	133
Poultry ...	85	85	77	75	86	70
Milk	70	70	90	90	90	130
Butter ...	77	76	71	72	73	65
Cheese ...	51	41	36	55	60	29
Potatoes ...	14	1	3	8	7	129
Hay	54	52	45	45	47	41

Wheat remains practically stationary and oats show little change on the month, but barley shows a substantial decline. Prices of fat stock remain about the same, on the average, sheep alone showing a slight fall. There has been little variation in the average prices of dairy cows and store cattle, but a further rise is recorded for store pigs, while store sheep, although more than maintaining their price, were relatively cheaper in December than in November compared with the corresponding pre-war months. Prices of eggs fell heavily during December, and are now much lower than they were a year ago. Milk and butter again maintain their relative values, but a further rise in prices of cheese is recorded. Potatoes remain about the same.

* * * * * *

Conciliation Committees in Agriculture.

THE Merioneth and Montgomery Committee has reached an agreement for the payment of a rate of 31s. for a week of 58 hours to stockmen and wagoners and 28s. for 50 hours to other adult male workers. The agreement operates from the 15th January to the 30th April and includes a clause fixing the valuation of board and lodging at 16s. per week and board only at 13s. per week.

The agreement of the Derbyshire Committee for the payment of adult male workers at the rate of 7d. per hour on weekdays and 9d. per hour on Sundays has been extended until

the 14th February. The Cornwall Committee's agreement providing for the payment of 30s. for a week of 52 hours to adult male workers will continue in operation until the 31st March.

Average Wages.—It is estimated that the weekly wages of ordinary agricultural labourers in England and Wales averaged during December about 27s. 10d., *i.e.*, about 55 per cent. above the pre-war level. In several areas, especially in the North of England and in Wales, the wages were in excess of this amount, but in such areas the average working week was generally longer than in the lower paid counties.

* * * * * *

TURNIP THINNING AND HARVESTING.

TURNIPS and swedes are the most important root crop of the British farmer, about 900,000 acres being grown annually in England and Wales. It is one of the most expensive crops to grow, not only because of the cost of preparing the land for sowing and of the after cultivation, but also because of the amount of labour required for thinning or singling the early plants, and for lifting, topping, and tailing the matured crop. Machinery has as yet taken no very prominent part in thinning or harvesting operations, and with the co-operation of various manufacturers the Ministry arranged a series of investigations with a view to determining the cost and efficiency of mechanical methods in comparison with hand labour. Whilst the results which are set out in the following Reports are not entirely conclusive, they yet point to the possibility of machinery being devised which should lead to a reduction in costs.

It should be explained that the thinning investigation was confined to turnips, while the harvesting investigation was confined to swedes. The thinning or gapping of roots by machines does not effect complete singling and is best adapted to those root crops which are to be folded. Although the point has not actually been investigated, it is hardly open to question that when the roots are to be lifted and stored it is desirable for the young plants to be singled by hand, and it is very doubtful whether there would be an advantage in a preliminary thinning by machine. The conclusions to be drawn from the data relating to harvesting would apply equally well to a turnip

crop, the only reason for selecting a swede crop being that swedes are invariably lifted while turnips are as a rule fed off.

Thinning.—The first test of turnip thinners was carried out in 1921 at the Ministry's experimental farm at Methwold, Norfolk, where the land is very light and sandy. The crop, however, proved a failure owing to the droughty summer and it was not possible to obtain any definite results. The test was repeated in 1922, when three machines were employed. A team of four men was engaged for the purpose of obtaining comparative results. A field containing 16 acres of turnips sown on the flat was selected for the test, and 48 rows (approximately 2.7 acres) were allotted to each machine and to the team of 4 men. Records were taken of the time required for thinning a given acreage, the labour needed, and any other relevant factor. For obtaining information as to the comparative effects of each device, small control plots were marked out and observations taken of the number of roots before and after thinning; and subsequently, of the number and weight of matured roots lifted from each plot.

Observations on the performance of each device and summary of results :—

(1) *Syme's Turnip Thinner.*—Manufactured by Messrs. Ord & Maddison, Ltd., Darlington. Price in April, 1922, £14.

Area thinned per day of 8 hours	4 acres.
Width of gaps	9 in.
Cost of thinning per acre	3s. 6d.
Weight of crop before topping and tailing	12·6 tons per acre.
" " after " "	7·3 " "

This machine is drawn by one horse led by a boy and requires a man to operate it. A revolving wheel or spinner is mounted at the rear of the machine and operates directly on the row by means of a series of ten blades shaped like hoes mounted on its circumference. This wheel is driven off a spindle geared to the main axle carrying the driving or land wheel: a hand clutch is provided for putting the spindle in or out of gear. The speed of the thinner can be varied to suit different soil conditions by using different gear-wheels. The depth at which it works can be adjusted by means of an overhead balance with spring counter-balance which the operator controls with a handle serving the double purpose of balancing and steering.

Under test the machine thinned the 2·7 acres in 4 hours 55 minutes, making gaps of about 9 inches between the roots. A spare wheel is provided with this machine with 8 hoes instead of 10; this leaves gaps of about 12 inches.

(2) *Parmiter Turnip Thinner.*—Manufactured by Messrs. P. J. Parmiter & Sons, Ltd., Tisbury, Wilts. Price in April, 1922, £18.

Area thinned per day of 8 hours	6·6 acres.
Width of gaps	12 to 15 in.
Cost of thinning per acre	2s. 5d.
Weight of crop before topping and tailing	14·3 tons per acre.
" " after " "	9·2 " "

The Parmiter is a double row machine. It has a main frame to which are attached ordinary shafts for horse traction. On the rear end of the frame two carrying spindles are mounted at an angle of about 45°, and have at their lower ends circular wheels, on the peripheries of which are mounted 12 plain hoe

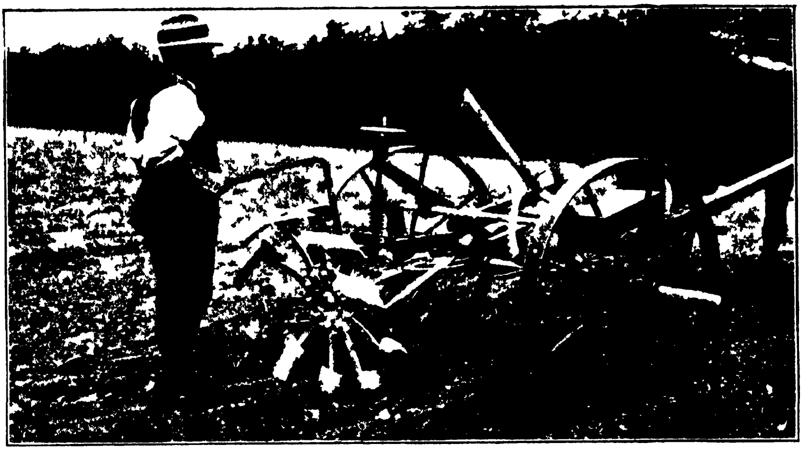

Fig. 1.—The Symes Turnip Thinner.

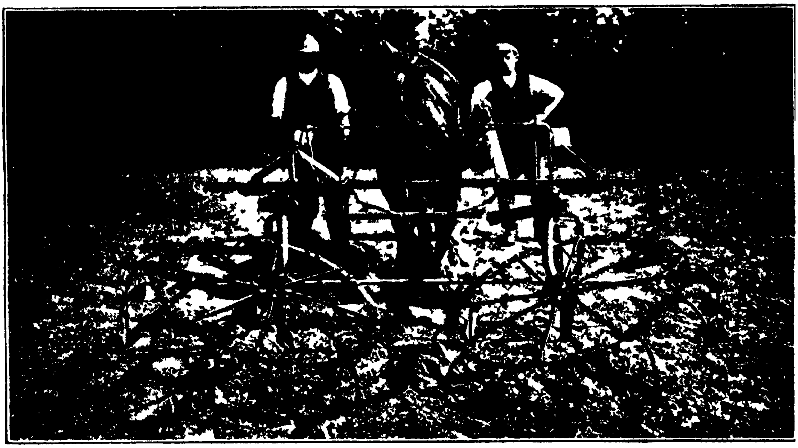

Fig. 2.—The Parmiter Turnip Thinner.

Fig. 3.—The Russell Turnip Thinner.

FIG. 4.—Portion of Plot gapped by Machine.

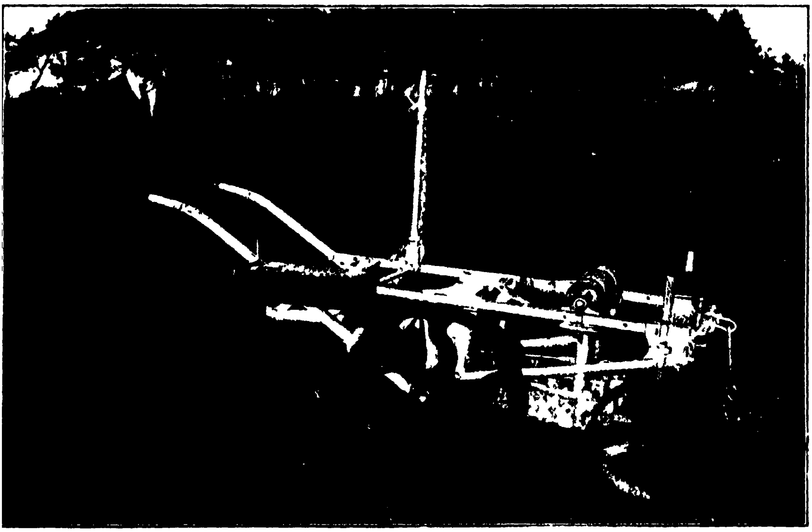

FIG. 5.—The Teasdale Topping and Tailing Machine.

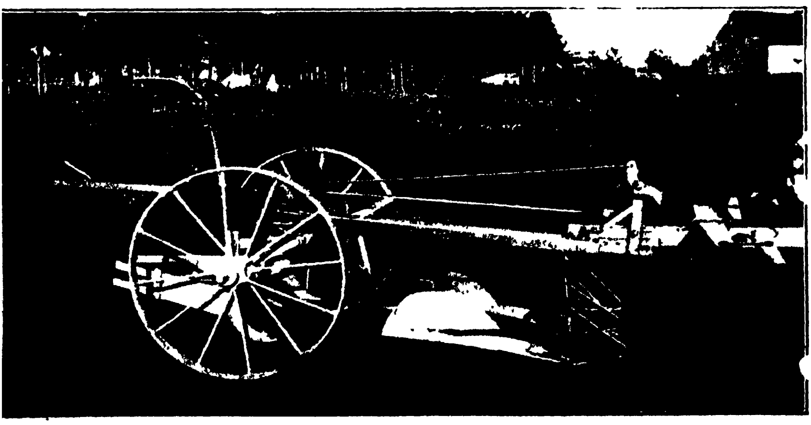

FIG. 6.—The Wigg's Topping and Tailing Machine.

blades at regular intervals. The forward motion of the machine when these blades are in contact with the ground rotates the gapping devices, which are counterbalanced by sliding weights. Handles are provided for the operator to control the digging and guiding action of the machine. A boy is required to lead the horse.

In the tests this machine made gaps in the rows of 12 to 15 inches. Being a double row machine it naturally showed a greater capacity than the other machines, thinning an area of 2·6 acres in 3 hours 10 minutes.

(3) *Russell Turnip Thinner.*—Manufactured by Messrs. The Maldon Iron Works, Maldon, Essex. Price in April, 1922, £14.

Area thinned per day of 8 hours	4 acres.
Width of gaps	10 in.
Cost of thinning per acre	3s. 10d.
Weight of crop before topping and tailing	17·3 tons per acre.
" " after " "	10·6 " "

This machine thins a single row at a time, is drawn by one horse and requires a man and a boy to operate it. There are many features which render it adaptable to varying conditions but in the main it does not depart from the design of the Syme's. A spinner unit at the rear of the machine is driven from gears connected to the main axle. The spinner carries 8 hoes, the angles of which are adjustable. In addition the diameter of the wheel may be altered as desired. The shaft carrying the spinner wheel is actuated by bevel gears through a universal coupling which enables the spinner to be worked on either side of the operator. A hand clutch is provided for putting the spindle in and out of action. Alternative bevel gears may be fitted to vary the speed of the spinner wheel, which is counterbalanced by a spring. Handles are provided by means of which the operator controls the spinner.

The tests of the Russell machine were not commenced till late in the day and consequently it only worked for 2 hours 42 minutes, during which time it thinned 1·4 acres.

(4) *Hand Labour.*—4 men.

Area of turnips thinned per day of 8 hours	3·9 acres.
Width of gaps	8 in.
Cost of thinning per acre	5s. 1d.
Weight of crop before topping and tailing	13·7 tons per acre.
" " after " "	7·9 " "

The men used ordinary hand hoes and worked extremely well.

Conclusions.—It will be seen that the machines were considerably cheaper and a little faster than the team of 4 men. With one exception, the yield proved greater where thinned by machine, though it should be noted that the machine-thinned turnips were on the whole of small size and growing in bunches.

The particular crop upon which the tests were carried out was grown for sheep folding, in which case the larger yield of the machine-thinned turnips was an advantage. The tests demonstrated the possibility of thinning or gapping turnips by mechanical devices at less cost and in less time than by hand labour with no loss in the total weight of the crop. It must be remembered, however, that the machines are not capable of singling the crop to be lifted.

Lifting, Topping and Tailing.—The lifting, topping and tailing of turnips by hand is a tedious and expensive process, and there is room for an efficient mechanical device for carrying out these operations cheaply and quickly. At present there

are very few topping and tailing machines on the market, and the Ministry was only able to secure the use of two machines for an investigation which was carried out on the experimental farm at Methwold in November, 1922. There are other machines in existence but they do not appear yet to have emerged from the experimental stage.

For the tests, three plots of swedes grown on the flat were selected. Each plot contained eight rows and represented an area of approximately ⅜ acre. The rows were 370 yd. in length and 2 ft. apart, and the swedes were about 1 ft. apart in the rows.

Observations on the performance of each machine and summary of results:—

(1) *Teasdale's Turnip Topping and Tailing Machine.*—Manufactured by Messrs. Teasdale Bros., Ltd., Darlington. Price, £22.

Area dealt with per day of 8 hours ...	4.5 acres.
Percentage of turnips topped	77·5
„ „ tailed	100
Estimated cost per acre	5s. 3d.

The Teasdale is a two-horse machine drawn by means of an ordinary swingle tree. The main structure is mounted on four carrying wheels. The fore wheels are each mounted on to a vertical shaft which permits adjustment of the front unit to varying depths. The rear wheels are also independently adjustable, and are on separate spindles connected to the sides of the framework. The left wheel and spindle carry a driving sprocket connected to another sprocket which actuates two canvas rollers by intermediate gears. These rollers are mounted between the forward frames of the machine and run vertical and parallel to them, and grip the turnip tops whilst they are being cut by a V-shaped knife mounted underneath. The rear of the machine carries a hoe blade which runs underneath the drill and tails and lifts the roots after they have been topped. Adjustments are provided for the chain suspending the canvas roller, and for the movable bracket carrying the tailing hoe.

There was a tendency for the front guides to become choked with cut leaves, and it was also noticed that careful steering was necessary, in order to get the tops in the centre of the cutter, and ensure satisfactory working. In its present form the cutter had a tendency to ride over the swedes; it is possible that had the back of it been slightly heavier the topping would have been more efficient. The tops of the swedes were small so that the canvas gripping rollers were not working to the best advantage.

It was observed that under certain conditions the machine had a tendency to skid and it is suggested that this difficulty would be overcome and the machine materially improved by employing a chain drive from both wheels instead of from the left wheel only. A disc coulter was attached in front of the tailing hoe but this was removed in view of the light nature of the soil and the fact that it had a tendency to cut some of the roots.

(2) *Wigg's Turnip Lifting, Topping and Tailing Machine.*—Agents, Messrs. W. E. Wigg & Sons, Burnby Foundry, Beccles, Suffolk. Price, £23.

Area dealt with per day of 8 hours ...	9·7 acres
Percentage of turnips topped	65·7
" " tailed	Nil
Estimated cost per acre	2s. 6d.

This machine is drawn by two horses, but operates on two rows at once. The Wigg is of Danish origin and consists of two units, a front and a rear carriage connected together by a secondary frame. No complicated gearing is involved. The topping of the root is effected by means of V-shaped shoes fitted with guards. The bottom of each shoe rests on the drill top, the V being knife edges whose sides serve as guides to align the plant to the V-shaped cutter. The shoes are adjustable by means of chains suspended vertically from the frame. The tailing devices consist of hoes attached vertically to the main frame, which is adjustable by means of a lever on the secondary frame. Further means of adjustment were provided for steering off the swingle tree and also for adapting the two operating units.

Prior to the tests this machine had been operated by a representative of Messrs. Wigg on a portion of the test ground, and during the test every endeavour was made to make it tail the turnips, but it failed completely in this. This machine was not so difficult to steer as the Teasdale, as provision was made for the topping cutters to have greater play. These cutters, however, became choked with cut leaves and had to be cleaned frequently. In addition to its failure to tail the swedes effectively the Wigg occasionally failed to lift and expose the roots. It is thought that this was due to the back blades being too deeply set on the standard and being badly shaped. The blades did not appear to have sufficiently good cutting edges.

(3) *Hand Labour.*—Two men.

Area topped and tailed per day of 8 hours	1·2 acres
Percentage of turnips topped	100
" " tailed...	100
Estimated cost per acre	8s. 2d.

Conclusions.—The tests clearly demonstrated that economy in time and money may be effected by machines where a considerable area of roots have to be dealt with. The Teasdale machine performed work at a speed equal to nearly 8 men and at approximately five-eighths of the cost. As an offset to this economy is the expense necessary for topping the 24 per cent. missed by the machine, but it may be expected that further experiments on the part of the manufacturers would result in a still more efficient machine.

The Wigg machine failed to tail the turnips owing mainly to a poorly designed cutting hoe. That this defect could be remedied without difficulty is clear from the fact that Messrs. Teadale's tailing hoe performed satisfactorily. The machine topped the turnips fairly satisfactorily.

TABLE I.—TURNIP THINNING: GENERAL RESULTS.

Methwold, July, 1922. Soil: Light Sandy Loam.

Device or Method	Labour	Working Time	Acreage thinned.	Acreage thinned per day of 8 hours	Average number of roots per row in control plots.			Weight of crop in control plots expressed in tons per acre *		Total cost of thinning each plot, including capital charges for machines	Cost per Acre
					Before thinning	After thinning	When grown	Before topping and tailing	After topping and tailing		
		hr. mins.								s. d.	s. d.
Syme's ..	1 man 1 boy	4 55	2·7	4·0	236	74	67	12·6	7 3	9 7	3 6
Parmiter	1 man 1 boy	3 10	2·6	6·6	207	101	98	14·3	9·2	6 4	2 5
Russell .	1 man 1 boy	2 42	1·4	4·0	281	66	58	17·3	10·6	5 3	3 10
Hand labour	4 men	5 40	2·8	3 9	289	58	53	13·7	7·9	14 1	5 1

* This is the result after weighing control plots when the crop had grown.

TABLE II.—TURNIP LIFTING, TOPPING AND TAILING: GENERAL RESULTS

Each plot was 370 yards in length (containing 8 rows of swedes) and having an area of 2/5th acre.

Methwold, November, 1922. Soil: Light Sandy Loam.

Device or Method	Number of men employed	Working Time	Average Time per row	Percentage topped	Percentage tailed	Acreage dealt with per day of 8 hours	Cost per Acre
		hrs. mins.	mins.				s. d.
Teasdale (single row) ..	1	44	5·5	77·5	100	4·5	5 3
Wigg (double row)	1	20·5	2·6	65·7	—	9·7	2 6
Hand Labour	2	5 20	20·0	100	100	1·2	8 2

The results so far obtained, although based upon so restricted a field, which is far from covering the possible mechanical methods of dealing with the problems involved, indicate that the prospects of efficient machinery for lifting, topping and tailing the root crop are reasonably good.

It is worthy of mention that no greater damage was caused to the roots by the machines than by hand labour, and such faults as have been revealed in the test ~uld doubtless be eliminated by further experiment.

It appears that the greatest possibility of future development lies in the direction of the double or multi-row machines; but further experiments with other types of land and conditions of growing must be carried out before adequate data will become available for any decision as to the most promising line of development.

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DUTCH BARNS AND COVERED YARDS.

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IN former articles reference has frequently been made to the difficulty of producing modern farm buildings at a sufficiently low capital expenditure to give an economic return, and it has been pointed out that the great need at the present time is to evolve simple and cheap forms of construction whereby improved accommodation and greater economy of labour can be effected. There can be little doubt for instance that the need is very great for cheap Dutch Barns and covered yards, and if such could be erected to produce an economic return on capital outlay considerable benefits would result.

One of the reasons for the high initial cost of farm buildings has been the conservatism of the English character, and the dislike to put up buildings other than in the most substantial and durable manner. A considerable part of the cost has been caused by a blind adherence to the use of the heavy framed timber truss roofs, even for quite small spans. Such methods are both wasteful in material and costly in labour, for carpenter's joints need skill and care in execution, and heavy timber scantlings cost more in proportion than light ones.

The evolution of timber framed trusses is, comparatively speaking, simple and has proceeded along the lines of large single tie beams and heavy scantlings framed into trusses, carrying heavy purlins and distributing the weight at isolated points of support. The use of heavy tiles and slates, as a roof covering, has necessitated considerable strength, and virtually, until quite recent years, there has been little or no development in new roof type forms, save by the substitution of iron and steel truss roofs, produced by big manufacturers, which require special skill in erection and considerable expenditure in maintenance. While there is no question as to the efficiency of these last-mentioned buildings, the cost and difficulty of erection, involving as it does the expense of transport both of skilled workmen and materials, has been a deterrent from their general use by tenant farmers or small holders, and even on large farms the abnormal cost of such buildings in recent years has made their economic erection an impossibility.

There is, however, a simple remedy. New forms of construction have been evolved based on three simple factors: the almost exclusive use of light timber scantlings so arranged that the erection is a simple matter for local unskilled labour; the use of creosote both as a preservative and means of reducing annual expenditure in maintenance; and the use of modern light covering materials such as galvanised iron, asbestos sheets, Trafford tiles, or Yorkshire spaced boarding as in the case of covered yards.

The solution is, in fact, a new and improved type of construction, which does not need elaborate carpenter's joints, heavy scantlings or greatly skilled labour, combined with a judicious use of new materials, and which, therefore, by lowered capital cost reduces the problem to the simple one of balancing capital outlay against improved economic results and a definite reduction in annual outgoings.

In the case of Dutch Barns, it is obvious that if a given area can be roofed in for a capital outlay which is more than met in a limited number of years by the saving on the annual thatching of an equal area of hay or corn crop, the advantages of the permanent roof, ready at all times and seasons, must result in improved profits and diminished risk of loss by inclement weather or bad seasons. The case of covered yards is, perhaps, more difficult to show in figures, but the expert agriculturist should have no difficulty in satisfying himself whether interest and sinking fund on his capital outlay will not

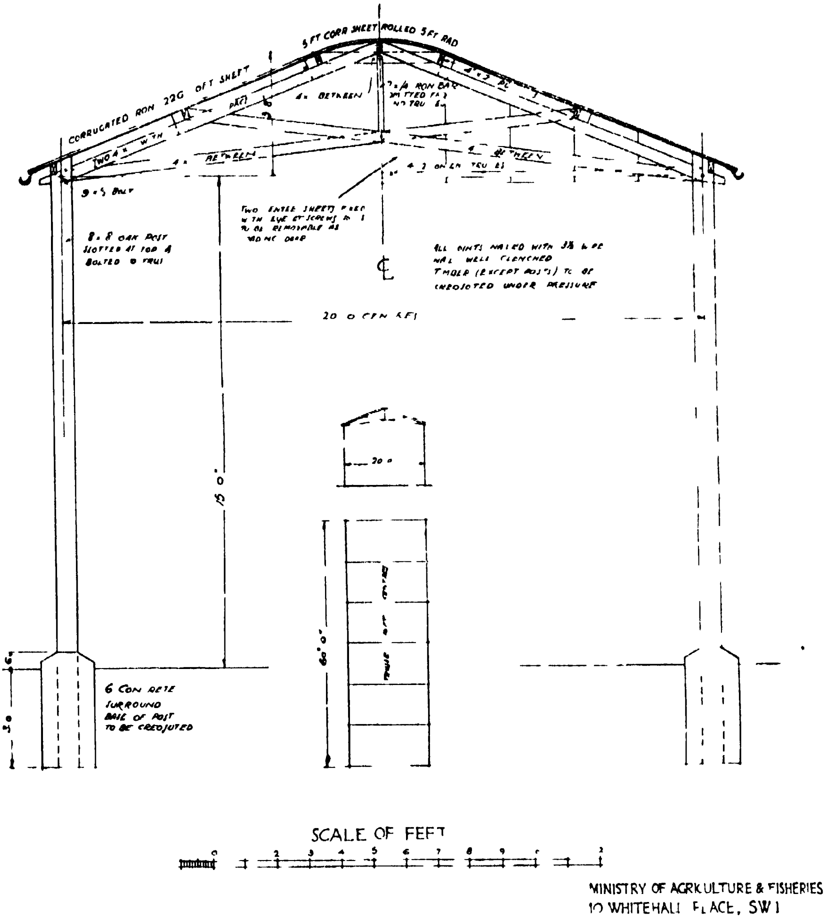

FIG. 1. Design for Timber Dutch Barn.

FIG. 2.—Dutch Barn (on right) erected at Papplewick Hall, Notts.

FIG. 3.—Dutch Barn at Papplewick Hall, Notts. Inside of Roof, showing trusses.

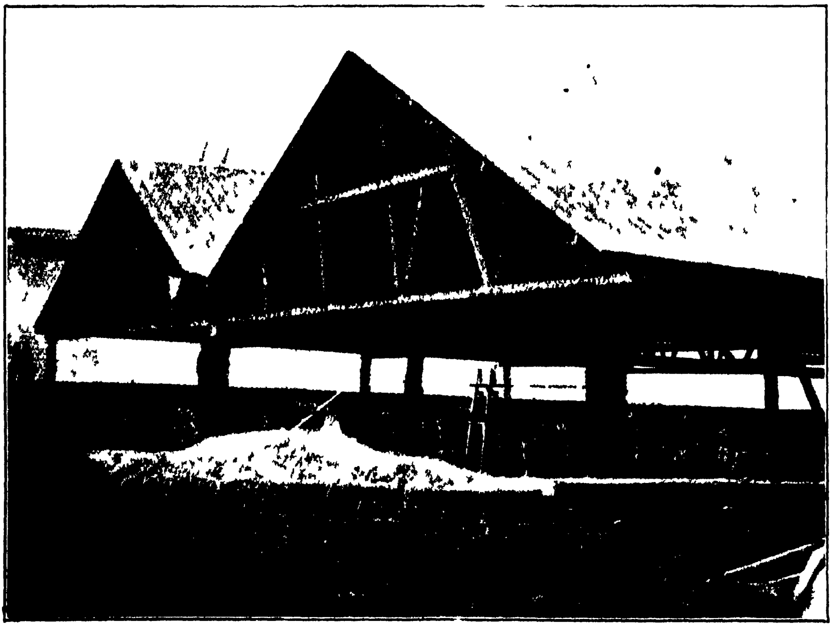

FIG. 4.—Covered Yard erected in Nottinghamshire.

be amply secured by the improved quality of his farmyard manure, reduced straw consumption and the greater head of stock he is enabled to carry.

The method advocated is in fact a return to the use of local materials wherever possible, home grown timber, when such can be readily obtained and converted, and such a simple method of construction that the village carpenters can, under adequate supervision, do all that is necessary. The principles here illustrated and described are in effect those which have been already advocated in former articles, particularly in the article published in this *Journal* for July last (The Planning and Construction of Cowsheds), to which reference may be made for further illustration of the use of small scantling timber in farm buildings.

The Dutch Barn of which a design is shown in Fig. 1 is intended to embody the principles enunciated above, and is, therefore, composed of materials easily obtainable locally, for even the galvanised iron used for roof covering can be procured in the smallest country towns. It will be seen that very light timbers are used for the trusses, only 4 in. by 1 in. in fact, not only to save in cost of material, but also to facilitate handling and erection. The necessary strength is obtained by making the rafters of two pieces of 4 in. by 1 in. and the cross ties and supports for the purlins are placed between them sandwich fashion, nailed and clenched. The trusses are best set out one on top of the other on the ground and erected either by first setting the posts in position and afterwards hoisting each truss and dropping it into the slots at the head of each post or, preferably, by fixing the truss to the posts when lying on the ground, tipping up into position and filling in round the feet of the posts.

The price of the barn as shown, 60 ft. by 20 ft., has been quoted at £110 made and erected, which works out at about 16s. 6d. per square yard covered. To thatch an equivalent area of hay or straw would require at least 20 squares of thatch, the cost of which may be counted as an annual charge entirely eliminated.

Figs. 2 and 3 are photographs of a barn of this design erected at Papplewick Hall, Notts, in the summer of 1922. Owing to want of space the span was made only 18 ft., and the posts were young oak trees cut on the estate. The cost in this case for all labour and materials (including a quotation for pitch pine posts) was just under £70 or under 11s. 8d. per square yard covered.

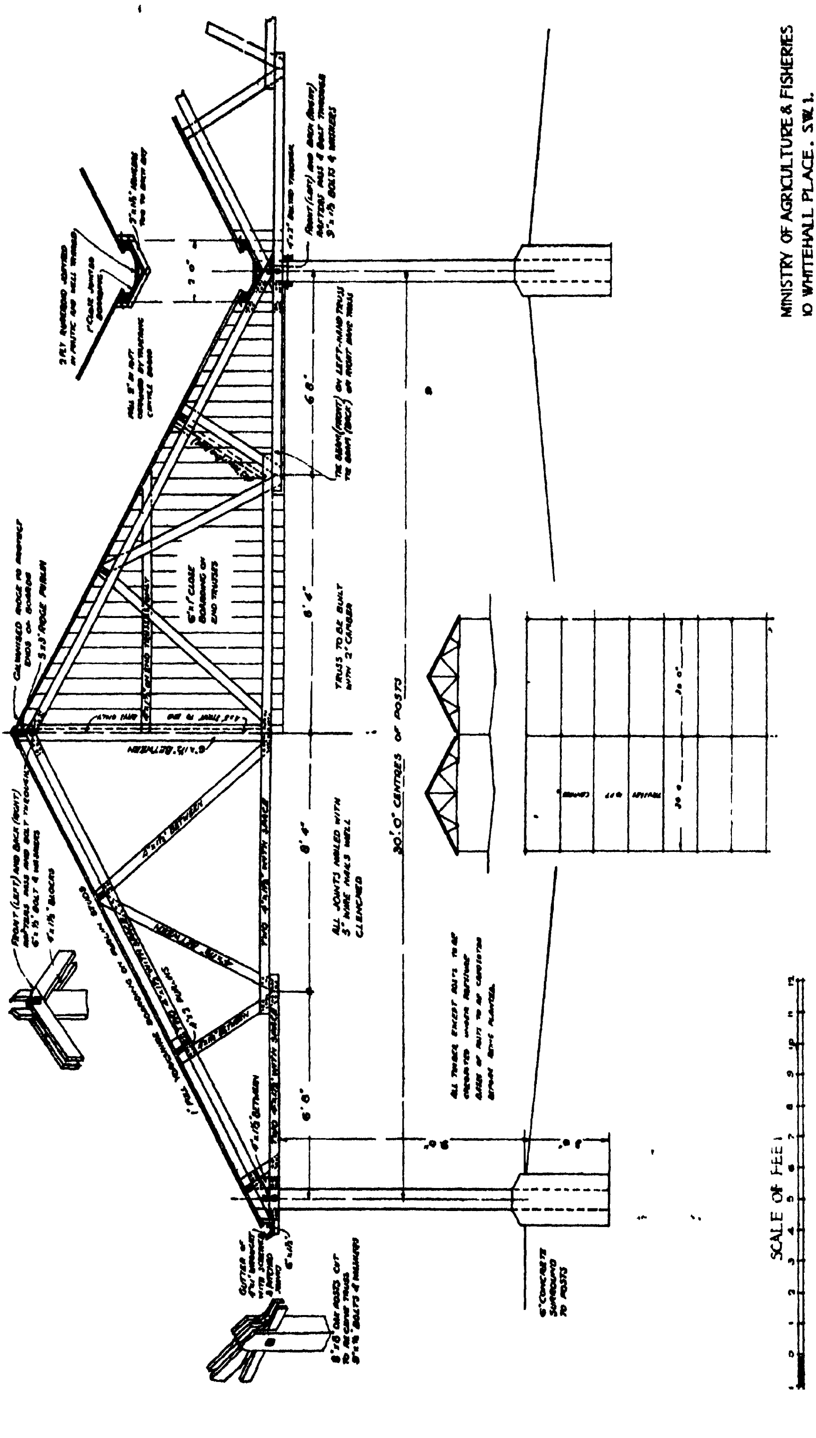

FIG. 5.—Design for light Timber Covered Yard.

Fig. 5 is a design for a covered yard adopting the same principles of light construction. The posts are of 8 in. by 8 in. oak, the trusses built up from 4 in. by 1½ in., double for rafters and tie beams and single for the members between, with 4 in. by 2 in. purlins, to carry the space boarding. The method of trussing is the same, viz., the single members are "sandwiched" between the double members and spiked. The weight of one of these trusses is under 3 cwt. so that handling is much more simple than it would be with a solid truss for this span.

Prices have been obtained within the last two months for covered yards very similar to this and they vary from 11s. to 15s. per square yard of ground covered.

Fig. 4 is a photograph of a covered yard in Nottinghamshire composed of two spans of 26 ft. 6 in., the length being about 45 ft. in four bays. The cost of this, exclusive of the posts, but including the cutting and fixing of them, was £147 or about 11s. 1d. per square yard of cover. All the timber was treated with creosote under pressure—except the posts, which were cut on the estate. The trusses are built of 4 in. by 1½ in. with rafters and tie-beams double and other members single. (The middle horizontal piece is only there for fixing the end boarding, and is omitted from other trusses.) The purlins are 5 in. by 2½ in. and the boarding 1 in. grooved space boarding.

It is an undoubted fact that this light framed construction is much cheaper than the usual solid construction used for barns and covered yards and of course much more economical than steel. Not only is the total weight of timber less but smaller scantlings are invariably cheaper than the larger ones. Again, the old roofs with their solid timbers and "joiner's joints" need labour of considerable skill, whereas semi-skilled labour with careful supervision has been found quite sufficient for such buildings as are here shown. Often has it been found that the joints in old roofs have been pulled apart by the very weight of the timbers themselves, whereas by sandwiching the members as shown the strengths of the joints more nearly approximate to the strengths of the timbers themselves.

A word as to coverings. The Dutch Barn has been roofed with galvanised corrugated iron, which has a reasonably long life except near factory towns; it can be painted or tarred after a few years if desired. In any case it is well worth while to tar the laps when laying the sheets.

Space boarding at the angle of 30 degrees has been found satisfactory in places of average rainfall, but where this is

excessive or where there is much snow the pitch should be steeper. Boarding covered with ruberoid and tarred would be quite weather-proof, but would be greater in initial cost and also in maintenance; it is generally considered that a space boarded roof renders the buildings much fresher and healthier for the beasts.

Yorkshire space boarding is made generally of two types: (1) with narrow deep grooves, and (2) with broad shallow grooves. The latter are to be preferred as the boards are stronger and they appear to carry off the water in as satisfactory a manner as the others.

The purlin studs are for the purpose of keeping an air space between the underside of the boards and the purlins. If the boards are nailed down close, moisture is retained at this point and may cause decay in the purlins or boards.

It is claimed that buildings of this description would have a sufficiently long life to more than justify their erection, and that they will adequately meet the purposes required. On many estates the whole of the timber could be obtained, and the judicious use of creosote, even if only brushed on, would reduce the cost of annual maintenance to a minimum.

The number of inquiries which have reached the Ministry recently with regard to economical farm building assured the writers that there is a very considerable demand for information and practical advice, and it is hoped that these illustrations and descriptions may be of use, if for nothing else than indicating the lines upon which further developments may take place.

* * * * * *

FARM CAPITAL AND PROFITS.

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THE system of tenant farming which is typical of English agriculture is virtually a partnership of three interests, the landlord, the farmer, and the labourer. It is not, however, an equal partnership. The landlord contributes the capital value of the land; the labourer gives his services, while the farmer has two shares in that he provides the working capital and gives his time either in actual labour or in management—or both.

Any return which the farmer receives from his farm can accordingly be regarded as partly payment for his work and partly payment for the use of his capital. Our study of farm accounts in the Economics Branch of the Department of Agriculture in Leeds University has shown that the final result of any year's working is influenced to a certain extent by the capital at the farmer's disposal, but to a greater extent by the way in which that capital is distributed and the use that is made of it. At the present time, when the economic returns from farming are so disappointing, a review of one of the factors responsible for success or failure appears opportune.

The Extent of Farm Capital.—For the financial year 1921-1922, 38 accounts of Yorkshire farms have been completed and these show that on the 9,308 acres covered, the total capital invested amounts to £153,346, which is equivalent to an average capitalisation of £16 9s. 6d. per acre. Even on the relatively small number of farms concerned the variations in capital per acre are so great that too much importance cannot be attached to this average. It is, however, interesting to note as an illustration of the magnitude of the industry that, on this basis, the agriculture of England and Wales absorbs more than three hundred millions sterling.

TABLE 1.

Variations of Capital with Size of Farm: Averages of 38 Yorkshire Farms.

Size of Farm	Average Closing Valuations per acre, 1921–22.				
	Live stock	Tenant Right	Produce	Implements	Total
acres	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
0– 50	15 11 5	5 12 1	2 5 10	5 13 4	29 2 8
50–100	7 1 4	4 17 11	2 7 9	3 16 1	18 3 1
100–150	7 16 3	4 3 0	2 18 7	2 17 2	17 15 0
150–200	6 18 0	3 5 7	2 12 4	3 10 7	16 6 6
200–250	7 13 0	2 12 8	2 15 3	3 18 9	16 19 8
250–300	5 15 11	1 19 11	1 7 7	1 14 11	10 18 4
Over 300	7 4 7	4 4 11	2 10 9	2 19 3	16 19 6

A glance at Table 1, in which the capital per acre on farms of various sizes is shown, brings out clearly the high capitalisation of small holdings. Up to the group 200-250 an increase in acreage of the farm is accompanied by a decrease in the capital per acre. The farms in the next group (250-300 acres) are mainly feeding farms and their low capitalisation is

due to understocking in anticipation of a slump in prices. Had they been fully stocked with beasts a more normal figure would have been obtained, and the relation between size of holding and capital invested per acre would have been roughly in inverse proportion.

Capital Essential for Success.—The most successful of these 38 farms was very highly capitalised, having nearly £26 invested per acre. Another farm with even more money per acre made a substantial loss. Of the 18 farms whose capital was above the average, 61 per cent. sustained losses, while of the remaining 20 with capital below the average, 55 per cent. failed to pay their way.

TABLE 2.

Relation of Total Capital to Profit or Loss.

Farm	*Capital per acre*	*Profit*	*Loss*
P.	£26	53%	—
G	£25	—	35%
M.	£18	8%	—
E	£17	—	21%
W.	£15	8%	—
A	£13	—	25%

In Table 2 figures are shown of farms with high, average, and low valuations. There is a fairly close agreement in the capital per acre of the two examples in each group, yet the results shown in the next columns as profits or losses expressed in terms of the capital invested do not similarly correspond. It would seem that there is no definite relation between the total capital employed and the profit or loss, always providing that the amount available is sufficient to meet the needs of the farming system adopted.

The Disposition of Farm Capital.—To secure a uniform basis for comparison, the total capital of each farm has been divided under four headings, namely: (1) Live stock; (2) Tenant Right; (3) Produce; (4) Implements. Of these terms only one requires amplification, the other three being self-explanatory. Under the term "Produce" is included all crops on hand whether for feeding or for sale, all foods and manures purchased and not yet used, and all expendable stores such as binder-twine, oil and veterinary preparations. The following table shows in what proportions the capital of the 38 farms was disposed.

TABLE 3.

Disposition of Capital at Closing Valuation, 1921-1922.
38 *Yorkshire Farms comprising* 9,308 *acres.*

	Total	Per Acre	Percentage of Total
	£	£ s. d.	
Livestock	66,964 ...	7 3 11 ..	44
Tenant Right ...	35,622 ...	3 16 7 ...	23
Produce	22.829 ...	2 9 0 ...	15
Implements	27,931 ...	3 0 0 ...	18
Total	153,346 ...	16 9 6 ...	100

The significance of this analysis lies in the fact that it shows at a glance what a burden of unproductive capital the industry has to carry. The capital invested in live stock and tenant right can be regarded as in circulation. When live stock or animal products such as milk and wool are sold, the capital invested under this heading is turned over. Similarly crops sold or fed are the proceeds of the labour, seed and manure included under the term " Tenant Right," the money invested in which is accordingly being turned over. Produce and implements, however, represent money lying idle. The one may be regarded as raw material waiting to be manufactured (such as manures and foodstuffs) or as manufactured foods waiting to be sold (such as crops harvested); the other is dead stock on which no profit is expected and the depreciation of which is regarded as a charge against profits. From Table 3 it will be seen that in this sense only 67 per cent. of the total capital is in circulation on these farms, the remainder lying idle in the form of implements and produce.

TABLE 4.

Influence of Capital in Circulation on Profits.

Farm	Percentage Capital in circulation	Profits as percentage of Capital
D.	74	12
I.	80	15
		Loss as percentage of Capital
G.	49	35
C.	56	31

As it is only on the capital in circulation—that is on the money turned over—that profits can be made, the importance of having as large a sum as possible so invested is obvious. The point is strikingly brought out in Table 4, a comparison of the returns from farms where more than the average capital is in circulation with those from others where less is so invested.

As an example of a bad disposition of capital the following quotation from a report sent to one farmer on his accounts for 1921-1922, is instructive:—

"The total capital invested in the farm on 31st December, 1921, amounted to £4,936 18s. 6d. or £25 9s. 3d. per acre. When, in the valuation, account has been taken of the falling value of stock, it would appear that the farm is suffering to a small extent from over-capitalisation, and to a large extent from not having the capital laid out to the best advantage. The summary of the farm valuation shows that 37·7 per cent. of the capital was invested in live stock, 11·4 per cent. in tenant right, 39·4 per cent. in implements, and 11·5 per cent. in produce. The money invested in live stock and tenant right may be looked upon as capital in circulation, that invested in implements and produce as capital to a large extent lying idle. In this case more than half of the capital is invested in dead stock, whereas if a farm is to be run at the present time on economic lines, at least 70 and if possible 75 per cent. of the capital must be put into circulation."

It has previously been noted that small holdings have a higher total capital per acre than larger farms, and it is interesting to see if this increased amount is invested where it can be used or if it is locked up in an unproductive form. Table 1 shows that the true small holdings have nearly as much money per acre invested in live stock as the farms above 100 acres have in all the divisions of the valuation. The tenant right is also higher per acre than in any other group. Produce is about the average, but the amount invested in implements shows up the weakness of the small holding. (What co-operation could do in this respect is beyond the scope of this article, but the facts presented are certainly suggestive.)

When, as is shown in Table 5, the figures of Table 1 are expressed for each group as a percentage of the total average capital per acre, several other points are brought out.

TABLE 5.

Disposition of Farm Capital on Holdings of Various Size (Expenditure as Percentage of Total Capital).

Size of Farms in acres	*Percentage of Total Capital Invested in* Live stock	Tenant Right	Produce	Implements
0– 50	53	19	8	20
50–100	39	27	13	21
100–150	44	23	17	16
150–200	42	20	16	22
200–250	46	15	16	23
250–300	53	19	13	15
Over 300	43	25	15	17

The figures justify the high capitalisation of small holdings, for in this group (0-50 acres) the percentage capital in circulation exceeds that in all other groups with the exception of the 250-300 acre farms previously mentioned. The small percentage of the small holders' capital invested in produce is difficult to explain, but two facts brought out in our dealings with this class of farmer are suggestive : (1) purchases are usually made in small amounts, and (2) although the buildings on these small farms usually provide adequate accommodation for stock, granaries and sheds for the storage of produce are often conspicuous by their absence. If these factors are responsible for the result noted, it would appear that the lack of storage facilities is from this point of view a blessing in disguise, preventing as it does the sinking of money in unproductive assets.

In the remaining groups the figures show a sufficiently close agreement both among themselves and with the average for all the farms (Table 1). With the exception of the 250-300 acre group the differences are so small that they can be accounted for on the basis of purely local conditions.

Capital Turnover.—When once a farm is sufficiently capitalised and when that capital has been advantageously disposed, as described in previous sections, the farmer has the best chance of success. One of the remaining factors which influences his profit or loss is what he *does* with his capital. On the 38 farms the total income for the year 1921-1922 was £159,041, or 104 per cent. of the total capital, or 155 per cent. of the capital in circulation. This turnover was insufficient to provide a profit when the results of all the farms are considered together, owing to the large depreciation which had to be allowed for in the year's accounts.

In an ordinary year it might be said that there is a reasonable chance of success if 80 per cent. of the total capital of a

TABLE 6.

Influence of Capital Turnover on Profits.

Farm	*Percentage Capital Turned over*	*Profits per acre* £ s. d.	*Loss per acre* £ s. d.
Average	104	—	1 2 9
P.	220	13 17 8	—
H.	180	1 2 3	—
C.	48	—	7 18 9
M.	49	—	3 5 7

mixed farm is turned over each year, and if not less than 120 per cent. be turned over on a dairy farm.

Table 6 shows the results obtained last year on two farms with a turnover higher than the average, and on two others where the turnover is less.

Although the difference in the economic returns on these farms cannot be attributed entirely to the differences in turnover, these latter were no doubt partly responsible. In writing to M. on the results of his year's working, it was pointed out that:—

> "Owing to the small turnover and in order to make a profit equal to double the rental, everything must have been sold so as to leave a net profit of 50 per cent. *Meadow Hay* produced at a cost of £6 14s. 3d. per ton must have been sold at £10 1s. 0d. per ton; *Potatoes* costing £3 2s. 7d. per ton must have been sold at £4 14s. 0d. per ton; *Wheat* costing £3 18s. 8d. per qr. to produce must have sold at £5 18s. 0d. per qr.; *Barley* produced at £2 8s. 0d. per qr. must have been sold at £3 12s. 0d. per qr.; *Oats* produced at £1 10s. 9d. per qr. must have been sold at £2 5s. 9d. per qr. The *Pigs* killed on the premises must have been charged to the house not at £16 6s. 0d. but at £21 1s. 3d. each. The 30 *White Faced Hoggs* bought for £90 and maintained at a cost of £19 1s. 6d. should have been sold before Christmas for £5 9s. 0d. apiece.
>
> "At the present time these prices are unobtainable, and the only available method of increasing the returns is by increasing the output."

The Influence of the War and the Recent Slump.—An examination of the annual variations in the capital per acre invested on one farm from 1914 to 1922 shows that following a slight decrease in 1915 a gradual appreciation in values took place until 1918, when a sharp rise is noted. The appreciation continued to 1921, and during the last year a sharp decline was felt. This decline continued, though probably in a less degree, during 1922. From the fact that in 1922 over £20 per acre was invested it will be seen that this farm was highly capitalised, but this was necessarily so, owing to its nature. The curve, however, may be taken as indicative of the variations which have occurred during the period under review.

An outstanding case of the effect of the slump has recently come to our notice. A farmer who commenced farming in 1918, when values were at their highest point, had £2,500 of his own capital and borrowed £2,500 from other sources. Part of this sum has recently been called in and as the farmer was unable to raise the money his affairs have been put into the hands of the Official Receiver. A valuation has accordingly been made, the details of which are given below and compared with the same items on entry in 1918.

On the three items mentioned this farmer has lost over £2,500, which is equivalent to 58 per cent. of the capital originally invested under these headings, and is more than the whole of

The Effect of the recent Slump on Farm Capital.

	Valuation in April, 1918	Valuation in Nov., 1922	Decrease
Tenant Right	£2.160	£970	£1.190
Horses	973	275	698
Implements	1 231	600	631
Total	4 364	1,845	2,519

the capital he put into the business in 1918. Had there been no necessity to repay part of the loan or had he been able to raise another loan there is every indication that this farmer would have been able to weather the storm. This, and numerous other cases which have recently been investigated, all point to the inadequacy of the present facilities for the provision of short-term loans.

The Effect of Purchasing a Farm.—That farmers have in recent years been purchasing their holdings is a fact which is frequently brought up as evidence of the prosperity of the industry. An investigation of the facts of the case in Yorkshire has been undertaken, and some of the economic results are here presented.

Of 52 farms whose accounts are now kept by the department of agriculture of Leeds University, only 7 were owned by the occupier before 1918. Since that date 13 others have been purchased, and the total area now farmed by the owners is 6,358 acres or 49 per cent. of the whole land costed.

Full details were obtained from nine of the thirteen farms recently purchased, and similar facts relating to four other farms, whose accounts we do not supervise, were also available. From these farms, comprising 3,164 acres, it would appear that the farmers concerned have had to find £92,905 which is the total purchase price of the acreage mentioned. This gives an average purchase price of £29 7s. 3d. per acre. How this sum has been raised is shown by the following facts:—(1) the average sum paid off amounts to £10 1s. 8d. per acre; (2) the average sum on mortgage is £12 15s. 4d. per acre; (3) the average sum as Bank Overdraft £6 7s. 1d. per acre; and (4) the average sum as other loans is 3s. 2d. per acre. Only 35 per cent. of the purchase price has accordingly been paid off, the remaining 65 per cent. being raised as loans of one kind or another. The average rent on these 3,164 acres

previous to purchase was £1 7s. 6d. per acre. The present annual charges, allowing 5 per cent. on the amounts paid off and charging actual rates on overdrafts and mortgages (approximately 5¼ and 6¼ per cent. respectively), amount to £1 16s. 3d. per acre. This sum includes tithe and land tax but makes no allowance for repairs. The purchase of the farms has thus increased the annual charges by 8s. 9d. per acre.

The paying off of even the small proportion of the purchase money previously mentioned has seriously hampered the tenants in many cases. Two tenants, when faced with the necessity of purchasing their farms, had to move to smaller farms than those they were farming as tenants. One took in a partner and used the extra capital so obtained for his deposit. Another, a dairy farmer on a small holding, reduced his herd from 19 to 12 cows. Several obtained fresh capital by the realisation of other securities, while one in paying a deposit so reduced the working capital that a second mortgage had to be arranged.

In conclusion, the various points brought out may be summarised as follows:—

(a) On 38 farms of 9,308 acres the capital invested per acre was £16 9s. 6d. Provided sufficient capital is available for the system of farming adopted, the total sum appears to have little effect on the economic returns of the holding.

(b) Of the total capital on any farm at least 70 per cent. should be in circulation.

(c) With sufficient capital at his disposal and with this advantageously disposed, the next point to consider is the capital turnover. If on a mixed farm at least 80 per cent. and on a dairy farm 120 per cent. of the capital be turned over each year, the farm stands a chance of success.

(d) The recent slump in agricultural prices has so reduced the working capital of many farmers that the provision of short-term credits appears necessary.

(e) In the case of thirteen farms recently purchased only 35 per cent. of the purchase price has been paid, and the total annual charges on the land are now 8s. 9d. more per acre than the previous rent.

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THE FEEDING VALUE OF OAT STRAW.

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McCOLLUM in America* has shown that cows and their calves can be raised to perfection on the complete maize plant alone, although maize grain is well known as a very incomplete food, and that straw is the most likely thing in the world to correct for deficiencies of grain feeding. The difficulty is to obtain straw that is eatable.

The experiments on the feeding value of oat straw which were begun at Armstrong College, Newcastle-upon-Tyne, in a tentative manner some years ago,† have, since October, 1920, been carried out more extensively, thanks to a special grant from the Ministry of Agriculture. The 1920 and 1922 crops were much damaged by wet weather, but the three years' experiments have, nevertheless, helped to determine those differences in feeding value which naturally occur in oat straw, and those conditions which are needed to obtain a high feeding value. The experiments also indicated a reason why farmers in some districts can feed cattle on swedes and straw, whilst in others they find it impracticable to do without some concentrated food.

The first subject investigated was the sugar content, but it was found during the progress of the investigations that the albuminoids appeared equally important. The chief digestible carbohydrate of oat grain is starch, which on digestion yields the same sugar as that which occurs in turnips, yet the sugars found in the straw are very similar to those found in honey,‡ and confer a high degree of sweetness on the straw. Samples of oat straw from many parts of Great Britain have been examined for their chief constituents, and as far as possible the conditions in which the straw was grown have been recorded. The investigations of the nitrogenous matter showed that the proportion of non-albuminoid nitrogenous matter was so small that all the nitrogenous matter in straw may be considered as of a high feeding class, in contra-distinc-

* McCollum: *The Newer Knowledge of Nutrition* (Macmillan), pp. 100.

† Collins & Spiller: Sugar in Oat Straw and Cattle Food, *Jour. Soc. Chem. Ind.*, 1920, p. 66. T.

‡ Collins: The Estimation of Lævulose (Fructose) in Straw, *Jour. Soc. Chem. Ind.*, 1922, p. 56. T.

tion to swedes, in which much of the nitrogenous matter is of doubtful feeding value.

Effect of Manure on the Composition of Oat Straw.—By dividing the results of the analysis of oat straw into three groups, the following comparative quantities are found (unless otherwise stated the results are calculated from the 1919, 1920 and 1921 crops*):—

35 samples of oat straw grown on soil containing very much organic nitrogen, such as may have been derived from old grass ploughed in, omitting doubtful clover takes, but including land which had received heavy dressings of farmyard manure:

Lævulose or honey sugar	1·0 per cent.
Total sugar	2·5 „ „
Albuminoids	3·8 „ „

29 samples of oat straw which had been top-dressed with sulphate of ammonia, usually about 1 or 1½ cwt. per acre, but otherwise poorly manured:

Lævulose or honey sugar	1·6 per cent.
Total sugar	3·3 „ „
Albuminoids	2·5 „ „

21 samples of oat straw grown with little, if any, nitrogenous manure in any form:

Lævulose or honey sugar	1·6 per cent.
Total sugar	3·5 „ „
Albuminoids	2·6 „ „

The combinations of these results which give significant differences are:—Much organic nitrogen gives an oat straw richer in albuminoids than that given by little or no nitrogen to the extent of 1.27 per cent., as judged by 56 tests. Much organic nitrogen gives an oat straw richer in albuminoids than that given by sulphate of ammonia top dressings to the extent of 1.30, as judged by 64 tests. Organic nitrogen manures give oat straw richer in albuminoids than that given by all other systems of manuring, to the extent of 1.28 per cent. as judged by 85 tests.

Other probable but less certain results are:—(1) organic nitrogen manures depress the amount of lævulose in oat straw, and (2) sulphate of ammonia is better than organic nitrogen for sugar production. Both of these two last results only refer to small differences of about 0.5 per cent.

The general conclusion, on the effect of manure on the composition of oat straw is, that ploughing in old lea with a good clover take, or applying much farmyard manure, results in

* Collins & Thomas: The Sugar and Albuminoids of Oat Straw, *Jour. Agric. Sci.*, 1922, p. 280.

producing an oat crop, the straw of which will be so much richer in albuminoids or flesh formers, that 18 cwt. will go as far as a ton of straw grown on poorly treated land, but as regards sugar content the proportion is the other way about. Nitrogenous dressings applied to the land, or feedings given to the beasts in the byre, tend to raise the fertility of the farm, and their effects are cumulative, whereas the value of sugar goes away with the beasts to market.

Effect of the Different Districts on the Composition of Oat Straw.—It was possible to select only a few farms to represent large areas, and the names of the districts must not be taken too literally. In some cases personal knowledge permitted the farms to be fairly well scattered, so that county Durham is fairly well represented, but the name of Scotland simply refers to the average of results from a few places well to the north of Northumberland. Yorkshire is represented almost entirely by the Garforth Experimental Farm, only a few other places in the county being among the list of farms from which samples were obtained. The Southern Counties district is more widespread, since it includes Derby, Notts, Essex, Herts, Bucks, Hants and Wilts, and may fairly be considered to represent "the South" from a North-countryman's point of view. In spite of these drawbacks in the classification, the following useful comparisons may be made :—

Albuminoids in Oat Straw in Different Districts.

Scotland with 20 samples gives 3·2 per cent. of albuminoids.

Northumberland and Durham with 26 samples give 3·2 per cent. of albuminoids.

Cumberland and Westmorland with 15 samples give 4·4 per cent. of albuminoids.

Yorkshire with 27 samples gives 3·1 per cent. of albuminoids.

Southern Counties with 34 samples give 2·7 per cent. of albuminoids.

A striking result is the much higher amount of albuminoids in Cumberland and Westmorland. Oats are a very important crop in those counties, and receive more manure than is customary in other parts of the country. They frequently follow old leas and often receive much direct application of dung. If we put Cumberland and Westmorland aside and compare the other districts there is at once the striking result that albuminoids increase as one travels northwards. The difference between the Scottish figure and the figures from the Southern Counties is marked and is quite in accordance with the popular impression that straw can be fed to beasts in Scotland in a

way in which it could not be fed in the South of England. At Cockle Park one experiment with different dates of sowing seed showed that the total nitrogen in the crop per acre was similar in amount; with autumn-sown oats the large crop of grain took nearly all the nitrogen but the spring-sown oats gave only half the grain yield and left straw which was very rich in albuminoids. It follows that in Scotland with its short growing season the grain will not be able to exhaust the straw to the same extent as it would in England and that therefore Scottish oat straw will on the average contain more albuminoids than English oat straw.

A partial answer is given above to the well-known question:—Why can cattle be fed on straw and roots in Scotland and in the North of England but not in the South of England? It may be due to the superiority in albuminoids of north country straw. It is very possible that along with the albuminoids will also occur those little understood food accessory substances which are sometimes called vitamines. Swedes and turnips are very poor in albuminoids and the superiority of northern straw in this respect may be the determining factor in feeding stock. At Cockle Park in feeding trials on hay the determining factor is often the percentage of albuminoids. North country hay is poor in albuminoids, whereas north country oat straw is relatively rich. These facts go a long way to explain the different practices in feeding cattle, since, in the northern counties hay has a lower value and oat straw a higher value than in the south.

The variation in the albuminoids in oat straw grown in different districts may be partly due to rainfall. In Scotland, Northumberland, Durham and Yorkshire, the average rainfall at the places where the oats were grown was about 30 in., but the Cumberland and Westmorland areas have an average rainfall of about 45 in., and the Southern Counties area of about 27 in. Among other causes of high proportions of albuminoids may therefore be placed a good supply of water. Oats that are cut green may be cut green because the season is wet, with the result that the straw contains more albuminoids, hence the cattle relish the straw and the farmer says that the straw is sweet, but it is rich in albuminoids and not particularly rich in sugar. Succulent green food is usually richer in albuminoids than old and stalky fodder.

The District in which Oats are grown and the amount of Sugar in the Straw.—Seasonal influence plays such a great part

in sugar production and content that 1920 and 1921 do not give the same results. In 1920 Cumberland and Westmorland headed the list, Northumberland and Durham being only a little behind; but in 1921 the Southern Counties gave much higher amounts of sugar than the Northern Counties. From these results it is clear that the Southern Counties made good use of the dry season of 1921.

General Conclusions.—Fine weather during harvest appears to be essential for obtaining high percentages of sugar. Sugar gradually disappears from the straw after harvest. When straw is very dry, loss is small; but when damp the sugar is quickly lost. Under average conditions high sugar content is not common, but, under careful management, six months' old straw has been found very rich in sugar. Variations in the percentage of albuminoids do not follow the same laws. Harvest weather has little to do with the amount of albuminoids, which depend chiefly on the amount of nitrogen supplied to the root and the amount of nitrogen demanded by the grain. Roughly, it may be said that the more nitrogen the soil contains, the more albuminoids there will be in the straw, but much will depend on the amount of grain produced.

The general impression obtained during the course of these investigations is, that the reason why feeding oat straw and swedes is so successful in one district, and not in another, may be summed up in the phrase "good husbandry." When a farmer thoroughly understands cattle he obtains more dung which gives him better quality straw and roots. Feeding these again skilfully to more beasts gives him still more and still richer dung until he is able to feed beasts almost entirely on straw and roots because both are rich in albuminoids. Ultimately, of course, the farm will reach such a high degree of fertility that the local climate and soils do not permit of any further advantage. The lowest figure obtained for albuminoids is 1.1 per cent. and the highest 8 per cent., a variation so large that it is capable of explaining any difference in feeding value. Poor samples of hay often contain less than 8 per cent. of albuminoids. The highest total of sugar is 9.7 per cent. and the lowest 0.3 per cent. In other words, good oat straw has a higher feeding value than inferior hay. Old leas ploughed out and plenty of "muck" give high albuminoids; fine harvest weather gives much sugar. It is good management that secures the benefits of both these improvements in composition.

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WHAT IS "GROUND LIME"?

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THE differences between quick-lime; ground limestone, ground chalk or other forms of fairly pure carbonate of lime; and waste limes (usually impure forms of carbonate of lime) have been repeatedly explained and emphasised in numerous bulletins and reports issued by Agricultural Colleges and by various authorities responsible for agricultural education.* The relative values of these materials for agricultural purposes have been fully explained in most of these publications, but it has perhaps not been sufficiently emphasised that any or all of these substances may be, and are, sold under the name of *lime*, with or without a qualifying adjective.

At the present time many inquiries are made showing that there is still a good deal of misunderstanding as to the nature of some materials sold for the purpose of "liming" land. The loose way in which the term "lime" has been, and still is, employed is really responsible for this confusion.

The term *lime* should only be used for the material produced by burning either limestone or chalk, whether the product is ground or not.

If ground it is usually referred to as "ground lime"; if it is not ground it is often called "lump lime," "shell lime," "clot lime," or simply "quick-lime." Quick-lime, lump or ground, is the most concentrated material which can be bought for "liming" land. A fair average sample would contain 80 to 90 per cent. of calcium oxide; a good sample may contain over 90 per cent.; whereas samples, especially of ground lime, often contain less than 80 per cent. of calcium oxide, and occasionally what should be regarded as poor samples contain less than 70 per cent.†

In lump lime, shell lime, clot lime, or *ground lime*, therefore, the main constituent should be *calcium oxide*, and the proportion of all other constituents, including *carbonate of lime*, should be low—say in the neighbourhood of 5 per cent. of each.

A farmer who intends to buy the material widely and correctly known as *ground lime* should make certain that it is *burnt lime*

* See Leaflet No. 170 published by and to be obtained from the Ministry. Also Report No. 107 obtainable from the Department of Agriculture, The University, Leeds.

† These remarks on percentages of calcium oxide do not apply to magnesian limes for which the total of the percentages of the oxides of calcium and magnesium should be substituted for the calcium oxide of pure limes.

or *quick-lime* (ground) which he is obtaining and for which he is paying the price of quick-lime.

Materials are now sold, and sold at prices for which ground quick-lime can be obtained, which are not ground quick-lime at all, but which nevertheless are called ground lime.

The writer does not wish to suggest that there is any intention on the part of vendors to mislead the buyers; on the contrary, the leaflets issued by vendors advertising the materials which are not quick-lime, but which are sold under the name "ground lime" are frequently accompanied by an analysis which makes it clear to those who can properly interpret a chemical analysis that the chief constituent is not calcium oxide (lime) but calcium carbonate.

This article is written in the hope that it may draw the attention of *vendors* as well as buyers to the confusion surrounding the names of these materials, particularly "ground lime."

An inquiry from the Secretary of a branch of the National Farmers' Union may be given as a typical instance of the numerous inquiries received during the last few months.

Two materials were offered to farmers, and were called respectively "ground lime" and "ground burnt limestone." The analyses accompanying samples of these materials were roughly as follows:—

	"*Ground Lime.*" per cent.	"*Ground Burnt Limestone.*" per cent.
Calcium Carbonate	96·0	94·5
Moisture	0·4	—
Silica, etc.	3·6	5·5

According to these analyses the materials were for practical purposes identical. The second analysis, however, was not an analysis of the material as sold—in fact it did not do the material full justice, as it was probably an analysis of the limestone rock from which the burnt lime wase produced. It could have been called "ground lime" instead of ground burnt limestone. On the other hand the material labelled "ground lime" was not entitled to that name as the chief constituent was *carbonate* of lime and the analysis in this case did apply to the material as sold. The correct name would have been "ground *carbonate* of lime," or simply "ground limestone" or "ground chalk" if the material was produced directly by grinding either limestone rock or chalk. (A good limestone and good chalk are practically the same chemically; they differ only in the structure of the rock itself which affects its hardness, etc.)

There are two other points to which attention should be drawn. There would be less need to worry about the names given to the burnt and unburnt materials if they were equally valuable *ton for ton* for the purpose (liming) to which the farmer puts them.

Ground limestone and ground chalk (under whatever names or trade-names they may be sold) are often quoted at prices per ton as high as and sometimes higher than the price of ground quick-lime. The former contains when dry say 96 per cent. of carbonate of lime, and would give an analysis of only about 53 per cent. of *calcium oxide*, whereas a ground quick-lime of good quality should contain over 80 per cent. of calcium oxide.

Many of the samples of ground limestone or ground chalk to which this article refers are excellent materials to apply to land; many of them are very finely ground, and it is on the fineness of grinding that their value depends. The writer has nothing whatever against the materials, and in the majority of cases in which lime is applied to land they would form just as satisfactory a material to use as ground quick-lime, but it requires rather less than 2 tons of finely-ground limestone or chalk to supply the same amount of the effective calcium oxide as 1 ton of ground quick-lime will supply. It follows, therefore, that the price per ton of a ground limestone or ground chalk *on the field* should be only about *half* the price per ton of ground quick-lime on the field. The price on the field is emphasised because of the extra (practically double) cost of transport and distribution in the case of the ground limestone or chalk.

Individual replies which the writer has had to such criticisms have been to the effect that finely-ground limestone cannot be produced at half the present price of ground quick-lime (except as by-products—waste materials). If that is the case then the method employed is not an economical method of reducing limestone or chalk to a condition suitable for application to the land.

The cost of producing a ground limestone or ground chalk so fine that over 90 per cent. of it would be immediately available when applied to the soil is high compared with the cost of grinding the same stone sufficiently to ensure that say 60 to 70 per cent. is of the requisite fineness. Although the coarser particles in the latter are of very little, if any, use when applied to the land the only harm they do is to lower the grade of the ground limestone and consequently to increase the cost of transport, since a

rather heavier dressing of the lower grade material will be required to supply the same weight of the effective fine material. The total absence of grittiness in a ground limestone may be necessary for other commercial purposes to which the ground limestone is put, but it is not necessary in agriculture. There is, therefore, an upper and a lower limit to the fineness of grinding of a limestone or a chalk for application to land—remembering that the material must compete in the market with quick-lime. The upper limit is determined by the cost of obtaining the last degrees of fineness: as soon as the cost of grinding becomes heavy enough to make the price of ground limestone more than half the price of ground quick-lime then ground limestone should lose its agricultural market. The lower limit is determined by the costs of transport and application of the larger dressings necessary when using low grade materials. If the grinding is such that there is only about 10 per cent. of fine material then 7 tons of the material will be required to provide as much useful material as 1 ton of a limestone of 70 per cent. fineness and the cost of transport and application would be prohibitive.

It may be taken that ground limestone or chalk passing the 60-mesh (linear) sieve is immediately available—coarser material is of some little use, but is scarcely worth considering.

The writer wishes to emphasise the fact that he is not advocating the use of coarsely-ground limestone but of sufficiently heavy applications of material which will pass the 60-mesh sieve at a cost which will compare with an equivalent application of quick-lime.

A certain small amount of coarser material is, as a matter of fact, an advantage from the point of view of uniform distribution. It is much easier to spread, either mechanically or by hand, a ground limestone or chalk which contains a small amount of gritty material than one which contains no grit at all.

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THE INTENSIVE SYSTEM OF POULTRY KEEPING.

LIEUT.-COLONEL F. W. HARDY.

THE intensive system is the one most suitable for town dwellers, who usually have little or no accommodation for providing a grass run. It is always better in such cases to utilize

the available site for houses only, as small earth runs are hopeless in the winter months, unless covered in, when they might just as well form a part of the house. For those who live in the country, and are able to get the land, the semi-intensive or extensive systems are better. Feeding is also cheaper, as the birds are able to pick up some of their own food, while it is generally less expensive to buy grain and meals direct from the local farmers and millers than to purchase them from the corn-chandler.

On the other hand, much better prices can be obtained for eggs in towns, where people soon find out where reliable eggs are to be had, and there should be no difficulty in getting the highest retail shop prices or even a little more, for one's produce.

The essentials to success are:—(1) *Housing*, (2) *Feeding*, (3) *Watering*, and (4) *Cleanliness*.

(1) **Good housing** is extremely important, because the birds have to remain continuously indoors. It should fulfil the following conditions, and be (*a*) absolutely dry; (*b*) well-ventilated, yet free from perceptible draught; (*c*) light; (*d*) cool in summer, yet not unduly cold in winter, and free from violent fluctuations of temperature between day and night: these conditions are very necessary for the birds' comfort, and for egg production; (*e*) sufficiently large to allow at least 4 square feet of floor space per bird for light breeds, and 5 square feet for general purpose fowls.

It is a great economy to build one's own houses, and they can be constructed in accordance with the site available, *i.e.*, a purchased house which would do quite well for southerly aspect, might be unsuitable if it had to face west.

Floors can be made of various materials.

(*a*) Wood is good but moderately expensive, as it is no use having a thin floor, or one not properly supported. It should be either well raised above the ground to admit of a dog or cat getting underneath, or a trench must be dug around the house to the depth of a foot, and 1-in. mesh wire netting buried in this, and attached to the walls. Otherwise rats will prove troublesome.

(*b*) Concrete or tarmac are both expensive, and should not be used unless the site belongs to the poultry keeper, or is held on long lease, because such a foundation becomes the property of the landlord. Concrete is cold unless well covered with litter.

(c) Earth is a good and cheap material, and is more natural for the fowls' feet than (a) or (b). An earth floor may be made both rat- and damp-proof as follows:—

Some cheap fir planks, 1½ in. thick and 7 in. wide, and costing about 2d. per foot, may be cut to the length required to make a rectangular frame ¼ in. less in each direction than the framework of the house. They should be creosoted very thoroughly, then, after being placed on edge, united at the four corners with screws or long nails. The site having been roughly levelled, the frame may be placed in position and set square. This is most easily done by measuring the diagonals: when these are equal, the frame is absolutely true. Then with a spirit level it should be set quite horizontal. For a large frame, one or more cross ties will be necessary. It may now be filled in. Broken glass makes a good start, followed by clinkers from a furnace or destructor—usually to be had for the carting. The last two inches should be of clay, mixed with fine gravel, watered with a rose-can and well beaten with the back of a spade until quite smooth, and brought level with the top edge of the fir planks. The gravel is added to prevent cracking. In its absence, fine cinders or clinker will do fairly well. In a few days, according to the state of the weather, a hard, dry and impervious flooring should result.

The writer has used no other kind of floor for the past 3 years, and has found it uniformly satisfactory. Occasional repairs may be necessary, but are easily effected.

The Walls can be made of various materials, but all require a framework. It is best to make each wall separately and unite them by screws, or bolts and nuts. A house can then be quickly dismantled, and re-erected elsewhere. If at any time it is desired to sell it, purchasers are willing enough to take it.

1½ in. by 2 in. battens are quite sufficient for the framework of a house capable of accommodating 30 birds. For the uprights of the sides, however, 2 in. by 2 in. scantlings are best. The important point in frame construction is never to make halving joints, except at the ends of timbers. Elsewhere mortise and tenon, or in small houses butt joints, should be used.

It is a convenience to build houses on the semi-detached principle, because, however few birds are kept, there will be both pullets and hens requiring accommodation, and these will not prosper so well if kept together. The partition may be of wire-netting with a draught board at the rear and a wire door in front. The entrances to these pens should be at the sides, *not* in front, so that the lighting may be unobstructed. The door-posts should be mortised to the framework of the sides. The slope of the latter is important, as on this depends the fall of the roof. A drop of 1 in 4 is convenient, because rain will run off sufficiently rapidly, while calculations are much simplified, measurements on the slope being $\frac{1}{32}$nd longer than those made horizontally. Thus a house 8 ft. deep will be 8 ft. 3 in. on the slope, and to allow of sufficient overlap, the roof should be 9 ft. The walls of the house can be made of matching, feather boards, asbestos-cement, or bituminous felt.

The last-named is a very cheap and effective method, and will be further described when dealing with the roof. The front is the most complicated. It

should be not less than 6 ft. 6 in. high, but 7 ft. is better. The top 4 ft. should be covered with 1 in. mesh wire-netting (nothing bigger will keep out sparrows), the lower half of the netting being protected in front by hinged glass shutters. Above these and behind the netting, are jute hessian screens for use at night time in cold weather. When not required, they fasten back to the under-side of the roof (Fig. 1). These screens—which extend upwards to within 8 in. of the top—allow of considerable perflation of air, but prevent all draught. Above the wire netting is a projecting hood, which prevents rain driving in at the front. These details can be clearly seen in Fig. 1.

The top member of the framework of each side should be halved into the front and back uprights, 1½ in. below their summit, so as to admit the purlins of the roof taking their support from them.

The back is very simple, except that in houses over 6 ft. deep ventilators should be placed immediately below the dropping board; these can either be of glass, hinged below and falling inwards, so as to direct the incoming air on to the under-surface of these boards, or they may be of perforated zinc, which, while admitting air, will prevent any violent draught. One of these, 15 in. long and 6 in. deep, may be provided for every 5 ft. of wall space.

The Roof is often very inadequate, not so much as regards leakage, but through being far too thin, and therefore very cold in winter, and baking on a hot summer day. A cold roof produces down-draughts on the birds while perching, and will effectively stop them laying. The following construction will be found very effective both for summer and winter use; at the same time, it is cheaper to build than the ordinary pattern:—

It is convenient to use 1½ in. by 2 in. battens set on edge. The framework should be rectangular and the rafters spaced 17¼ in. apart, centre to centre. This will allow the felt, which is always 1 yd. wide, and which should run from front to rear, overlapping 1½ in. exactly on the rafters. Having made the framework and proved it true, the underside should be covered with bituminous felt secured to the rafters with plasterer's laths fixed with 1-in. nails. The frame should then be reversed and the intervals between the rafters be packed with straw. Over this should be placed 2-in. mesh wire netting tightly stretched, and fixed with staples. Over this should come another layer of felt secured with laths as before. This makes an admirable roof. It is supported on two or more purlins running from side to side and 1½ in. by 3 in. in section. The ends of the purlins are halved, so as to rest on the top members of the framework of the sides, whilst the roof is securely fixed to the walls with four or more long screws. For a large house the roof can be made in sections.

The Fittings.—Dropping boards are essential, not only from the point of view of cleanliness, but because of the part they play in ventilation, by admitting air beneeth them, without the birds on their perches being exposed to direct draught. They should be sufficiently wide, say 2 ft. 6 in., and the same height or a little more above the floor. They should make a tight joint with the back wall, yet be easily removed when required. A

fillet $\frac{3}{4}$ in. thick should be nailed along the front to enable the birds to get a secure hold when jumping up. Tar or thick creosote makes a good and impervious coating. Where possible they should be cleaned daily. If cleaning can only be done at the week-end they should be freely dusted with dry earth, wood ashes or peat moss, so as to prevent the droppings sticking, and to absorb moisture.

Perches should not be fixed in sockets but should rest on wooden blocks placed on the dropping boards. These blocks should be treated with creosote or paraffin at least once a month, as also the perches. It is as well to keep a few spares, as creosote and paraffin are liable to blister the birds' feet, unless quite dry.

Water vessels and grit boxes are best fixed on the outside, the birds having access through slits cut in the walls. The slits should be sufficiently above the floor to avoid litter being scratched into the receptacles, and a small perch will therefore be required.

Nest boxes may be inside or outside. Fig. 1 shows a good arrangement. A lifting roof is preferable to one falling outwards In wet weather the eggs must be taken from the inside.

A wire rack for vegetables is a convenient method of feeding odd leaves which cannot well be hung.

Another type of house deserves mention—the half-monitor (Fig. 2). This is a cheap and effective method of enlarging the floor space. Both houses in this illustration have been so enlarged.

A third type is very strongly recommended, combining the advantages of the span- and pent-roof, viz., the $\frac{3}{4}$-span. It is a little more difficult to construct than the house described above. A model plan of this type can be obtained from the Ministry, price 4d. post free.

Litter.—The question of litter is of the greatest importance. The natural method for a hen to take exercise is that of scratching, not jumping. Fowls that have no exercise rapidly put on fat and soon cease laying. It is therefore necessary with poultry kept intensively to provide them with ample scratching exercise. This is effected by burying their grain ration in deep litter. The best kind is undoubtedly straw, which may be mixed with dry leaves when the latter are available. A little fresh straw—and leaves—should be added from time to time, and after scattering the grain, the latter should be quickly raked in. Peat moss may be used in place of straw, but the latter is preferable as the resulting product is much more useful for the garden.

(2) **Feeding.**—There are three systems of feeding:—(*a*) Wet mash; (*b*) Dry mash; and (*c*) Combined wet and dry. In all three methods a certain amount of grain is also fed.

(*a*) *Wet Mash* is very suitable where only a few birds—say a dozen or thereabouts—are kept, because the house-scraps provide a considerable proportion of the food. On this system the scraps are minced and set aside on the kitchen fire to simmer in water for some hours. The resulting product is then mixed, whilst still hot, with various meals, and placed in a hay-box. Afterwards it is dried off with middlings to a crumbly consistency, and fed to the birds in troughs.

(*b*) *Dry Mash* has come greatly into vogue of late. It is an immense saving of labour. The various meals are mixed dry, and fed in hoppers which are open all day, or for a limited time only, according to the concentration of the mash. It is very suitable for intensive work, because it affords the birds occupation. After eating for a short time they must go away for water, and then return. One may be delayed in getting home to feed the birds, but they never starve. They are also less subject to diarrhœa, and other digestive disturbances.

(*c*) *The Combined Wet and Dry Mash method* is very useful where it is desired to use household scraps, but it is not usually possible to feed the birds before evening, owing to other occupation from home. On this system the birds should have grain raked into the litter early in the morning, when the water-vessels should be emptied and re-filled. A member of the household should open the dry mash hoppers for four hours in the middle of the day, and the wet mash can be given last thing at night, by the light of a lantern when necessary.

A great advantage of dry mash is that it keeps quite well when stored in closed receptacles. One can make up, say, a fortnight's supply at any convenient time. The composition of mashes is too big a subject to be dealt with fully here, but a simple dry mash for laying hens is as follows:—

	lb.	
Bran	1	This is for use in winter. In summer add another lb. of bran, and reduce the Sussex ground oats to 1 lb.
Alfalfa meal ...	1	
Middlings	4	
Sussex ground oats ...	2	
Maize meal	1	
Fish meal	1	

There are several other foodstuffs well worthy of mention, including dried separated milk, dried yeast, maize germ meal and maize gluten meal. It is, however, often difficult to obtain

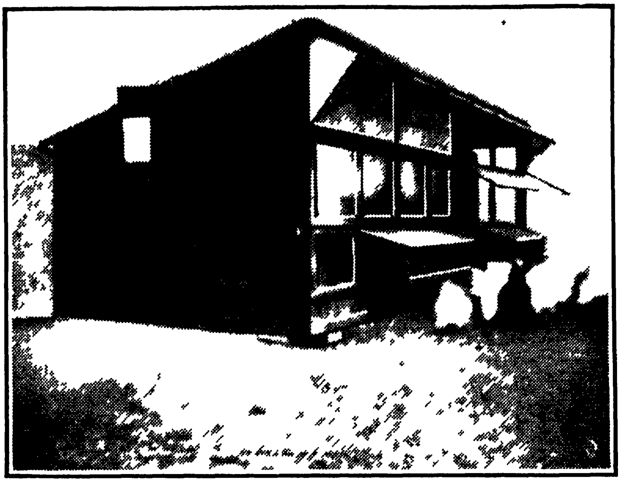

FIG. 1 Pent roof of open fronted Poultry House

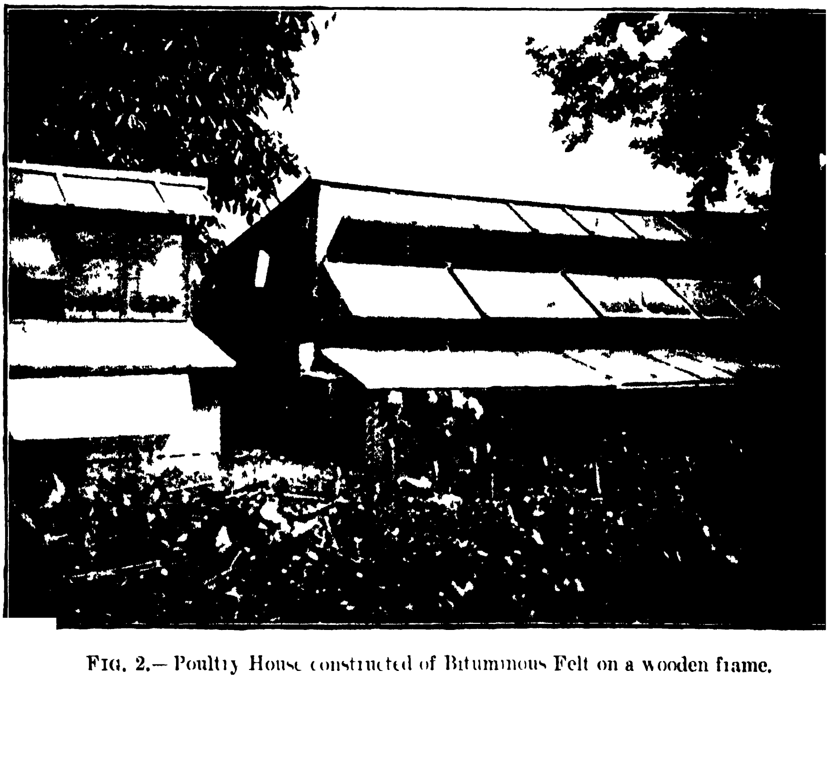

FIG. 2.—Poultry House constructed of Bituminous Felt on a wooden frame.

these in small quantities. In all feeding one should constantly handle the birds to note their condition, and make the mash more bulky or more concentrated as required.

About $1\frac{1}{2}$ oz. of grain per head should be given daily. Equal parts of wheat, oats, and cracked maize make a good mixture.

Plenty of green food is essential if fowls are to be maintained in health. Birds on free range consume it largely. In confinement it must be provided for them. On a very small scale, the greengrocer may be dealt with for waste fresh cabbage leaves, etc., but he will be found too expensive for larger quantities. Here the allotment comes in. A small patch of lucerne will provide an abundance of green food from the middle of April till mid-November, whilst thousand-headed kale, marrow-stemmed kale,* cabbages, lettuces, and the different kinds of spinach, will all contribute their quota, after providing for the house. In winter, swedes and mangolds are very useful, the former before, and the latter after the turn of the year. These are best bought early and stored in a clamp or shed, protected from frost. They should be fed raw. If split in two, and impaled on a nail a foot above the floor, the birds will pick out the whole interior.

Green vegetables are rich in vitamines and mineral salts. Mangolds and swedes contain Vitamine C. in large amount, the former also about $6\frac{1}{2}$ per cent. of sugar. Their mineral salts are similar to those found in green vegetables.

Fowls kept intensively will be observed to consume limestone grit, oyster-shell, etc., out of all proportion to the production of egg-shell, if their vegetable ration is restricted. How is this all to be regulated? We may safely leave it to the natural instinct of the hen. Let her have all the vegetable food she will eat, and when this is not possible, then include in the mash such things as alfalfa meal. Also, lime in some form, whether as limestone grit, or oyster or cockle-shell, should always be before the birds.

(3) **Watering.**—An egg contains about 75 per cent. of water, which is also required to regulate the concentration of the fluids of the body, to promote excretion of deleterious substances, and to control temperature by evaporation of moisture, through the medium of expired air. Birds should never be allowed to run short of water. It should be unpolluted, shaded from the sun, and protected from contamination. This is best effected by using open vessels that can be easily scrubbed and cleaned, and locating

* See Ministry's *Journal*, May, 1922, p. 177.

them outside the house as already explained. When the source of supply is of doubtful purity, a few drops of a solution of potassium permanganate may be added, but with this, earthenware, and not metal vessels must be used.

(4) **Cleanliness.**—Birds seem to pass most of their excreta during the night. The cleaning of dropping-boards has already been referred to. If the house be perfectly dry, those droppings which fall on the scratching litter soon dry, and much of them in due course is reduced to dust. Intensive houses should be cleaned out twice a year, in spring and autumn. All the fittings should first be removed, and then the litter taken away, and walls, roof and floor well brushed. If a piped water supply be available the house should be hosed down inside. Then the whole interior should be treated with a strong solution of some cresol disinfectant, using a garden syringe, and all be left to dry. After replacing the fittings. and putting in fresh scratching litter, the birds may be returned.

A continual war must be waged against red-mite, and for this purpose paraffin applied to the perches and dropping-boards is as effective and as cheap as any other insecticide.

Body lice must be kept down. For this purpose dusting boxes containing dry earth, may be provided. As a rule, however, fowls will only dust themselves—in winter-time at any rate—in the sun, and seem to prefer doing so on the floor of the house. A very little quicklime sprinkled in the litter; is considered to be a good insecticide.

In conclusion, the owner should be a friend to his birds. His movements should be quiet, the birds never being startled or frightened. It is the contented hen that delivers the goods.

Note.—Fig. 1 appeared in "Eggs," the Journal of the Scientific Poultry Breeders' Association, of 28th December, 1921, and my best thanks are due to the Editor and Publishers for the loan of the block. It shows the outside nest-boxes with roofs to lift up, the glass shutters—two open and two shut—and the jute hessian screens, of which two are buttoned back to the under surface of the roof and are consequently not seen.

Fig. 2 shows a house, the walls and roof of which consist of a double skin of bituminous felt, on either side of a wooden framework. It is an economical and durable method of construction. A half-monitor has recently been added.

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CROPS AND PLANT BREEDING: RESEARCH METHODS IN NORTH AMERICA.

I.

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THANKS to the facilities afforded by a Travelling Research Fellowship the writer was enabled to make a tour of some of the leading Experimental Stations in America during June and July last. It is proposed in this article (1) to give a brief account of the organization which exists in the United States for the purpose of co-ordinating research connected with crop culture and plant breeding, and (2) to discuss in more detail some of the methods actually employed in the conduct of these researches.* It is not intended to present an exhaustive account of the researches in progress and reference is made only to the limited number of Stations actually visited and to the work of investigators whom the writer had the pleasure of meeting.

Organization.—A clear-cut distinction is made between Animal Husbandry and Field Husbandry. Thus all the leading Experimental Stations have separate farms for the study of the problems connected with these aspects of agriculture. Crops are the concern of the Departments of Agronomy† at the Experimental Stations and of the Bureau of Plant Industry at the Federal Department of Agriculture. Plant breeding is

* Owing to illness it was not found possible fully to complete the tour as originally planned, and as a consequence it is regretted that, with the exception of the trials conducted at the Macdonald College, the writer was unable to see the work in progress in Canada. He had, however, the opportunity of meeting a large number of Canadian investigators at the Second Annual Convention of Technical Agriculturists of the Dominion, held at the Macdonald College in June.

† Agronomy has been defined in an exceedingly interesting paper by Piper (see Charles Piper, "Plants and Plant Culture," *Science*, new ser., vol. liii, No. 1,369, March, 1921) as the science of plant culture, and by Mooers (see C. A. Mooers, "The Agronomic Placement of Varieties," *Journal of the American Society of Agronomy*, vol. 13, No. 9, 1921) as "that branch of agriculture which treats of the theory and practice in the production of farm crops." Thus "Agronomy" as understood in America implies rather more than "Field Husbandry" as generally understood in this country; indeed, as practised and taught in the United States, agronomy covers the fields of both our Agricultural Botany and Field Husbandry. This is a fundamental and important difference, for whilst in this country the problems of field husbandry are chiefly the concern of the professors and lecturers in Agriculture, men who are also deeply involved in the problems of animal husbandry, in America they are the concern of the agronomist, who is by training an agricultural botanist and who devotes all his time and energy to crop problems.

regarded as being a definite branch of agronomy and is usually conducted either by an agronomist in general charge of a particular crop or by a "Plant Breeder" working under or in association with the Professor of Agronomy. At a few stations (*e.g.*, Cornell) agronomy appears to be treated as a branch of plant breeding, but be this as it may, there is always the closest possible association between the agronomist proper and the plant breeder.

The relationship between the Federal Department of Agriculture at Washington and the Experimental Stations can only be properly appreciated when the functions of the Technical Bureaux are understood. The Bureaux are in the main not only administrative but also research departments. Thus at the Bureau of Plant Industry, the Chief and all the heads of sections are technical men, practically all of whom are actively concerned with researches in the field. The closest contact is maintained between Washington and the Stations, and this is achieved by numerous researches being conducted co-operatively by the Bureau and the Stations. In some cases the salaries of special men are shared between the Bureau concerned and a particular Station, in other cases a Bureau man conducts his researches at several of the Stations. This plan appears to be fruitful of excellent results, for not only is intimate and personal contact maintained between Washington and the Stations—a contact which has rendered technical inspection superfluous—but also all the Stations working at kindred problems are kept in active and vital touch with each other. Further, from a purely scientific point of view the importance of an investigator having facilities to conduct the same researches over a wide area is of course inestimable.

Since the Bureaux are staffed by technical men it is to be expected that they and the Stations are competitors for personnel. This appears to be wholly an advantage since the staffs of both Stations and Bureaux consist largely of men who have served the one or the other previously, a fact which undoubtedly makes for cordial relations and sympathetic mutual understanding. The movement of men—even of senior men—from one post to another is not a particularly serious matter in the United States because technical agriculture is a profession absorbing, literally, thousands.*

* The technical staff at the Bureau of Plant Industry amounts to not less than 450, while the staff at the Kansas State Agricultural College at Manhattan totals about 186.

Moreover, every institute of standing has numerous post-graduate men doing research with the heads of departments, whilst every investigator in charge of any considerable research has at least one highly-trained and skilled assistant. Continuity of endeavour is thus amply safeguarded at the American Stations.

The administration and staffing of the Stations, which form an integral part of the State Agricultural Colleges, and which usually constitute a faculty of the University, are arranged with the needs of research kept well to the forefront. At most of the Stations visited the Director was also Dean of Agriculture and was thus head of the Station and of the College, when administrative duties permit of but little time for active participation in teaching or research. In many cases the heads of departments are research workers pure and simple, at most giving a few lectures to post-graduate students working in their departments; and always a large proportion of the staffs are men devoting all their time to research, while in practically all cases the members of the definitely teaching staff are themselves closely associated with the researches in progress in their several subjects. This arrangement, together with the presence of numerous post-graduate students, creates an atmosphere of inquiry, enthusiasm and good fellowship which is one of the most arresting characteristics of the leading Stations.

Very generous assistance is afforded to investigators relative to routine clerical work. Women stenographers and frequently also women calculators are allocated in plenty to the several departments—the calculating machine and the typewriter being regarded as the first essential of equipment. It is the ample clerical assistance which has made possible the elaborate recording, filing and abstracting systems everywhere in evidence. There is generally attached to the Station both a photographer and an artist.

The agronomy farms are devoted entirely to experiments; it is not the function of these farms to attempt practical farming as such but only to conduct experiments bearing upon the problems of crop culture. That this method of assisting the practical man is fully appreciated is evinced by the large numbers of farmers visiting the stations annually.

Agronomy is in America treated as an essentially outdoor science, and thus it has come about that around agronomy has developed a highly specialized field technique, a technique

which shows itself not so much in elaborate laboratory equipment as in special field and barn machinery and apparatus, ample and well-arranged greenhouses, and pot culture stations, and in remarkably thorough methods of conducting field trials, recording and interpreting the results obtained from them. All field trials are under the personal direction of the investigator, who frequently himself assists with the sowing, cultural and harvesting operations. During the growing season a large amount of this work is performed by students who are paid on a per-hour basis. At most of the Stations are to be found one or more invaluable non-scientifically trained but withal highly scientific foremen.

The Experimental Station stands pre-eminent in its State. Usually numerous sub-stations are maintained in connection with the headquarters Station. The extension work is conducted with due regard to the results obtained at the Station; thus the Director of Extension to whom the County Agents are responsible always has his headquarters at the Station.

Publications.—Publication of results is voluminous, and consequently the American literature is bewildering in its magnitude. In this country the view is frequently expressed that the volume of printed matter is unnecessarily large, a view which sometimes finds vent in the States also. It has to be remembered, however, that there are as many Experimental Stations as States in America and that the Stations are all conducting researches on numerous problems. Thus research in plant breeding is in evidence everywhere and not as in this country confined to a small number of institutions.

If serious overlapping is to be avoided frequent interim reports dealing with both methods and results are therefore a necessity. The regular writing up of the work in progress is also highly desirable in order to maintain continuity when changes of staff are not infrequent. The English investigator who is desirous of keeping in touch with American work and is not associated with a first-class library or assisted by a good abstracting system is certainly at a great disadvantage. Fortunately, however, in addition to the bulletins emanating from the Stations and Bureaux there are the American Scientific Journals, two of which in particular, namely the *Journal of the American Society of Agronomy* and the *American Naturalist*, contain matter of particular importance relative to plot technique, crop problems generally and plant breeding, though they are less generally found in our libraries than such well-known

periodicals as *The Experiment Station Record*, *Genetics*, *Journal of Agricultural Research* and the *Botanical Gazette*.

Seed Distribution.—In recent years many of the State Colleges have taken a prominent part in safeguarding the supplies of reliable seed within their province. The usual plan is to form a "Crop Improvement Association." The procedure adopted by the College at Manhattan, Kansas, for example, is briefly as follows:—The College pays the salary of a secretary and provides clerical help, while the members of the Agronomy Department inspect the crops. Membership is open to "any Kansas farmer of known integrity," and the subscription is $1.00 per annum. Members of the Association are eligible to have their seed certified. Seed is certified after inspection of the growing crop and of the harvested grain and then only in the case of standard varieties recognised by the Station as being well adapted for growing in Kansas, and which have themselves been sown with certified seed recommended by the Station. The previous cropping of the ground must also have been such as to preclude the possibility of mixing with varieties or lots of seed which may have been recently grown. At the end of the season the Station publishes a list of the names and addresses of members of the Association whose seed has been certified, together with the approximate quantity for sale. Seed is certified if all the conditions have been complied with and the inspection shows no serious defects; brief notes are, however, appended against each crop relative to freedom or the reverse from weeds, fungus diseases, and as to contamination or the reverse with other varieties.

In Kansas it has been found that the establishment of the Association has been a potent influence in the rapid distribution of improved varieties through the State. In the first instance supplies of seed are sent only to the élite of the members by whom it is subsequently further distributed.*

Methods of Research in Agronomy.—It is neither possible nor desirable to give here detailed particulars of the methods employed in the conduct of field trials. A great deal of work has been undertaken relative to methods, and much stress is laid on the difference between systematic error and non-

* In 1919 over 600 farmers were certified for "Kanred" wheat alone, and now this wheat and "Kanota" oats are firmly established throughout the State.

systematic error.* By "systematic errors" is implied errors that are inherent in an experiment and which cannot be countered by any amount of replication; "non-systematic errors" are those occasioned by soil heterogeneity and climatic conditions which can be greatly reduced by adequate replication and repetition year after year. In order to avoid systematic errors it is necessary to approximate as closely as possible to field conditions. Thus rows of cereals distanced far apart introduce scope for considerable systematic error, and varieties are affected differentially by competition and shading; plots separated by paths either unsown or sown with a different variety or species are likewise liable to grave systematic error. The general plan underlying the laying out of all experiments at the American Stations is to resort to plots of a size that will allow ample replication and to employ methods calculated to reduce systematic error to a minimum. The agronomy farms are always mapped into permanent blocks or "ranges" of as uniform soil type as possible. The ranges are usually designed to take oblong plots—for large scale trials seldom larger than 1/40 acre (the size commonly adopted at Arlington Farm, Washington, is 8 rods by ½ rod). Such plots are very generally employed for variety, manurial, rate of sowing and other trials. The influence of competition is countered by cutting and discarding the outside margin of the plots. In the case of cereals sowing is by drill and harvesting is performed by the binder or by hand with a scythe with a cradle attached.

It is usual to replicate the plots three to five times and to use a standard variety as a check introduced at regular and frequent intervals. At Knoxville, Tennessee, the produce of such plots is wrapped in hessian, which facilitates carriage and storage until thrashing.†

For small scale work the rod row is generally employed. Rod row plots are extensively used in breeding work—selection and elimination are largely based on the results of rod row tests conducted for five to eight years and it is only strains

* See Stadler, L. J., "Experiments in Field Plot Technique for the Preliminary Determination of Comparative Yields in the Small Grains," Research Bull. 49, Univ. of Missouri College of Agriculture, Agricultural Experiment Station, which gives a detailed account of the methods largely current and a critical review of the whole subject, with 18 references to literature.

† This plan was adopted at Aberystwyth last year with oat plots 1/100 acre and proved eminently satisfactory, the crops being kept several weeks before it was possible to thrash them.

that give satisfactory results from these small scale trials that are finally tested out on larger drill-sown plots.

A very considerable technique and an equally considerable literature has grown up around the rod row.*

In order to come as close as possible to field conditions, with cereals rod rows are usually sown about 1 ft. apart—the seed being sown in drills.† It is now generally held that it adds materially to the accuracy of the trial to resort to "protected" plots—that is to say, to provide border rows which will be eliminated at the time of harvesting. On this plan each lot would consist of three rows, the two outside rows being discarded for a one row trial, or of five rows for a three row trial. The rows should run north and south. Rod row trials of this sort run continuously without any paths except the main label paths. It is usual to replicate the lots from five to ten times and a standard variety or standard varieties are frequently employed as checks.‡

The extent to which the rod row plan is adopted was a revelation, and the extensive series of such plots at Columbia (Missouri), Manhattan (Kansas), and at Cornell (Ithaca, N. York) were most convincing. The three rows are valuable for the purpose of note taking and as a unit show differential lodging in a surprisingly convincing manner.§

The rod row trial demands special technique and equipment right up to and including thrashing. The final harvested row is at Manhattan carefully tied and the ears or panicles wrapped round with paper Special hanging arrangements are provided in airy drying rooms. These rooms usually consist of mesh wire sides and the bundles are hung in two tiers one above the

* See, e.g., H. H. Love and W. T. Craig, "Methods used and Results obtained in Cereal Investigations at the Cornell Station," *Journal of the American Society of Agronomy*, vol. 10, No. 4; T. A. Kiesselbach, "Studies concerning the Elimination of Experimental Error in Comparative Crop Tests," Research Bull. No. 13, The University of Nebraska Expt. Sta., June, 1918; H. H. Love, "The Experimental Error in Field Trials," *Journal of the American Society of Agronomy*, vol. 11, No. 6; and L. J. Stadler, *loc. cit.*

† Opinions differ as to whether the sowing is best performed by hand or with a Columbia drill—sowing by hand necessitates covering by hand, which tends to earth the drills up and therefore occasions a departure from field conditions. At Aberystwyth in the case of a trial with pure line wheats just sown this difficulty appears to have been overcome by rolling subsequent to covering.

‡ The advantages and disadvantages of checks and the precautions to be taken when employing them have been ably dealt with by Stadler (*loc. cit.*). whose paper should also be consulted for a detailed discussion relative to the *pros* and *cons* of the border row.

§ Only extensive trial can show whether the rod row test would be satisfactory in this country. Conditions favouring lodging are less continuous in the United States than, at all events, in Wales—a rod row trial badly lodged naturally presents almost insuperable difficulties relative to harvesting.

other from match-board horizontal supports. By careful arrangement all the plots of each lot are brought together and the whole produce of the trial hung and docketed in such a way as to be most convenient for thrashing. Thrashing is performed by special machines, which are designed to be easily cleaned, and are metal lined throughout, all crevices and cracks being filled with furnace cement. Under proper supervision and with adequate appliances and recording methods the rod row trial presents no particular difficulties, the men soon learning how to undertake the special work involved.

With herbage plants trials are chiefly conducted on broadcast plots. The yields are, however, in most cases reduced to dry weight; thus a part of the field equipment at Cornell is a special drying tower designed to deal with a great number of large samples (about 20 lb. green weight).

Dr. C. H. Myers at Cornell, realising the disadvantages of the broadcast plot, is now testing a method analogous to the rod row plan for strain trials with Timothy. It remains to be seen whether this will introduce a fundamental systematic error.*

In dealing with early selections and F1 and F2 seeds from hybridizations it is usual to plant in spaced rows, the row commonly employed being five feet. Actual crosses are at many of the Stations made under glass, while some of the investigators are enabled to grow their segregates at two Stations under widely different climatic conditions.†

Brief Particulars of some of the more striking Investigations in Progress.—*Variety Trials.*—A great deal of critical work is in progress relative to the conduct of variety trials and none more interesting than that of Professor Mooers. at Knoxville, Tennessee.‡

Mooers' extensive data obtained with maize in Tennessee serves to emphasise the absolute necessity of planting this crop at the correct spacing for each variety as such before attempting to make any quantitative comparisons relative to yielding capacity between one variety and another. His data bring out a further important point, namely, that the planting rate should vary according to the soil fertility, that is to say, accord-

* The row method of testing grasses and clovers is largely employed at Aberystwyth, and the matter is now under investigation in comparison with broadcast plots.

† See Love and Craig, *loc. cit.*

‡ See C. A. Mooers, "Planting Rates and Spacing of Corn," Univ. of Tennessee. Agr. Expt. Sta., Knoxville, Bull. No. 124, May, 1921, and "Agronomic Placement of Varieties," *loc. cit.*

ing to the expectancy yield. For maize in Tennessee on the richer soils more plants per acre are required than on the poorer soils. It would thus appear that in order to obtain reliable results from variety trials it is necessary to have arranged the spacing for each variety correctly having regard to the fertility of the soil upon which the trial is conducted. It has been the practice in this country to sow an equal number of germinable seeds per acre for all the varieties of oats or wheat included in a trial. It has, however, been realised by many experimenters that different varieties require different seed rates largely depending on the tillering capacity of the several varieties. It seems highly probable that with oats and wheat the fertility of the soil also exerts a profound influence on the most desirable seed rate, but as to whether the seed rate should be increased or decreased as fertility increases there is little or no available evidence in this country. Certain it is, however, that comparisons between variety trials conducted all over the country or even between those carried out within the confines of a single county are apt to be misleading or totally without significance until reliable data are collected as to the optimum seed rate required for leading varieties under diverse influences of soil and climate.

Mooers has also drawn attention to the importance of employing a reliable standard variety against which to compare the results from other varieties. He shows, moreover, that a good standard variety should be one that yields progressively well from poor to fertile soils; this, if the results are plotted from various soil classes the curve so obtained should be practically an oblique straight line. Thus, if the yields on two soil classes are obtained it is possible to prognosticate with considerable accuracy what the yields on other classes will be. The behaviour of other varieties relative to the standard then forms a scientific and accurate basis for correlating data from numerous variety trials. Mooers points out with truth that the agronomist cannot give really reliable advice as to choice of variety from a knowledge of the chemical and mechanical analysis of the soil only. The implication of his results is irresistible, *i.e.*, that better than, or at all events as well as, conducting soil and botanical surveys of a district, it would be more advantageous to map the district into soil classes by recording the behaviour of standard varieties of the chief crops, and this is probably a line of investigation well worthy of attention in this country. The work conducted by Helm

and Stadler at Columbia, Missouri,* is interesting, for they have shown that under the conditions of the short and hot growing season prevalent in that State, the early varieties of oats always outyield the medium and late, results which suggest the desirability of ascertaining for every characteristic district the relation of varieties to each other when grouped on a rapidity-of-reaching-maturity basis.

It is interesting to find the *Sterilis* varieties of oats so largely grown in latitudes where winter sowing is just possible. Fulghum and related sorts appear to be nearly as hardy as the ordinary Grey Winter (Winter Turf of America), but are in greater favour largely because they can be successfully employed as spring varieties also.†

New Introductions and Nationality Trials.—The United States and Canada alike owe much to species and varieties of plants which have been introduced from other continents; mention need only be made of Lucerne (Alfalfa) and pasture plants like Blue Grass (*Poa pratensis*),‡ Timothy§ and Japan Clover. It is therefore not surprising to find the testing of new forms and strains of species already introduced and of other species which may possibly prove useful amongst the most important activities of the Experimental Stations.

Interesting trials were seen with Japan Clover‖ at Knoxville, Tennessee, with species of *Lotus* at Arlington Farm, Washington, and with various species and forms of *Medicago* at the Macdonald College near Montreal. When starting serious breeding work with any particular species it is the first endeavour of the American investigator to "comb the world" for all possible forms and varieties of that species; this is well exemplified by the living museum of varieties of Sorghum under investigation by Professor Piper and Dr. H. V. Vinall at the Arlington Farm.

Interesting nationality trials with Red Clover were seen at several Stations (*e.g.*, at Arlington Farm and Knoxville, Tennessee) and it was noteworthy that the American-grown lots

* C. A. Helm and L. J. Stadler, "Productive Methods for Oats in Missouri," Circular No. 105, Agr. Sta., Columbia, Missouri.

† Fulghum and other *Sterilis* varieties have been tested as winter oats for two years at Aberystwyth. They have proved to be wonderfully winter hardy and very early to mature, but under our conditions are but slight croppers.

‡ See Charles V. Piper and Katherine S. Bort, "Early Agricultural History of Timothy," *Jour. Am. Soc. Agron*, vol. 7, 1915.

§ See Lyman Carrier and Katherine S. Bort, "The History of Kentucky Bluegrass and White Clover in the United States," *ibid.* vol. 8, 1916.

‖ This plant Piper (see Charles V. Piper, "Plants and Plant Culture," *loc. cit.*), informs us was introduced accidentally in 1858 and has now spread all through the South.

appeared to be more susceptible to Mildew (*Erysiphe polygoni*) than many of the European, and that Italian Clover does not prove to be winter-hardy in the States.*

(*To be concluded.*)

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RECENT DEVELOPMENTS IN RABBIT-KEEPING FOR FUR.

E. C. RICHARDSON.

BEFORE the War, rabbit-keeping in this country was in the main confined to fanciers who strove to produce animals as nearly as possible resembling hares, or who sought after this or that symmetrical arrangement of spots or other markings. Our main supplies of rabbit fur and rabbit meat were imported, as indeed they still are.

The Belgians have long been a nation of rabbit-keepers, and their exports to us took the form of the well-known "Ostend" rabbit of commerce, and of rabbit skins sheared and dyed to imitate the furs of various wild animals. Australia and other countries where wild rabbits abound were also engaged in this business, but the best meat and the best skins were, and still are, produced from hutch-bred rabbits.

Trade names for some of the imitation furs made from rabbit-skins are "Seal Coney," "Sable Coney," "Beaver Coney," "French Sable," "Electric Seal," "Seal Musquash," etc. The trade done in these commodities has long been a large one, and with the falling off of supplies of wild furs and the increased demand for all classes of furs, it is now greater than ever.

The Beveren Club.—With the War and the submarine menace came a great rabbit boom in this country. It is to be feared that the boom did no small amount of harm in some directions, but in one way, at least, it did good, for it led to the formation of the Beveren Club.

The Beveren Club was started to promote the breeding of all kinds of rabbits which had valuable pelts, and it was called the Beveren Club because the Giant Blue Beveren, which is

* Cf. results at Aberystwyth, see "Preliminary Investigations with Herbage Plants," Bull. Series H., No. 1; and R. G. Wiggans, "Home-Grown and Imported Red Clover Seed," *Journal of the American Society of Agronomy*, vol. 13, 1921, p. 334.

one of the best of our varieties, was the first rabbit to be adopted by the Club. Since the club was started several other good varieties have been added to the list, such as Havanas, Chinchillas, Champagne Silvers and others.

It soon became evident, however, that the breeding of these rabbits was not in itself sufficient to further the objects of the club. An outlet had to be found for the pelts and for the meat. The meat side of the problem did not offer any very great difficulty, for the rabbits were not kept, by most people, in very large numbers and the meat could be eaten at home. Moreover, there was already in existence a market for the meat, created by the Ostend trade. The pelts presented a more difficult problem, for these are beautiful things in their natural undyed and unshorn condition and, as indicated above, the existing trade in rabbit-skins is mainly confined to imitations.

The Fur Board.—Accordingly a sub-committee of the club was formed to deal with this question, and was christened "The Fur Board." The Fur Board* worked well for some time as a sub-committee, but again a difficulty arose. Money was required for the purchase of skins and the club was not a rich body. It was therefore decided to turn the Fur Board into an independent but friendly concern and to run it with private capital.

That was the position of affairs when, in the summer of 1920, the Great Eastern Railway Company started their Small Live Stock Demonstration Train. The Fur Board was asked to undertake the rabbit section on the demonstration train, and their display of furs and rabbits attracted much attention. Among other bodies interested were the Ministry of Agriculture and the Agricultural Organisation Society, and it was eventually decided that the interests of the movement as a whole would be better served if the Fur Board ceased to be a merely private concern and became a regular co-operative society affiliated to the Agricultural Organisation Society. This arrangement was carried through, and the present position is that anyone interested in rabbit-keeping can become a member of the new society which is now being run on the usual co-operative lines. The business of the society consists in the buying and selling of the *best* British rabbit skins (Beverens, Chinchillas, Havanas, Silvers, etc.), in the dressing of the skins, and in the making of them into high-class wearing apparel. The profits go towards paying a dividend on the

* Secretary, Mrs. Ker, "Heathgate," Bucklebury, Reading.

Left — Chinchilla Rabbit Stole and Muff *(Photo lent by W. S. Campbell)*,
Right —Blue Beveren Coat *(Photo lent by Daily Mirror)*

"Chinchillon" Child's Coat made with twelve Chinchilla Rabbit Skins *(Photo lent by D. W. Irving)*

share capital, after which they are divided amongst the members of the society in proportion to the value of the skins they have sold to the society, less a percentage (which is voted at the Annual General Meeting) to the Committee of Management by way of remuneration for their services.

The prices paid by the society for skins varies with the supply and the demand, and no fixed figures can be given, but as a rough guide it may be said that the best Beveren skins are at present valued at about 5s. each. As, however, the profits of the society are divided amongst the members, the price actually paid by the society by no means necessarily represents the full price ultimately received by the breeder of the pelts. During the season of 1921 the business of the society flourished and a bonus amounting to rather more than double the original value paid was paid to breeders, so that those who in the first instance received 5s. for their pelts ultimately received about 10s. or a little more. How the current season will turn out cannot as yet be predicted with certainty. All that can be said at present is that prospects seem to be fairly good.

Rabbit-Breeding as an Industry.—So much for the organisation which has been brought into being; and now for a few words of a general nature about this budding industry. Whilst the writer is of opinion that everybody who is in a position to do so (and there are few who are not) should keep a few rabbits for fur and for meat, he is not prepared to advise anybody—certainly not ex-soldiers and others who desire to start a definite business—to embark upon rabbit-keeping on a large scale. It is admitted that rabbit-keeping on a large scale *might* be profitable even now, and he is far from suggesting that it may not become so in the future, but under existing conditions the writer's view is as given above.

The rabbit undoubtedly fills a gap in the domestic economy of the nation. It can be fed, very largely, on all sorts of material which would otherwise be wasted, and which no other domestic animal will eat—with the possible exception of the goat. The initial capital required for rabbit-keeping is very small—considerably smaller than for poultry if the birds are to do well. Rabbits are silent animals, and that is no mean advantage in these days of motor horns and crowing cocks. They can be fed at any hour of the day or night. They do not retire for repose at sun-down after the manner of fowls. They do, how-

ever, need a good deal of individual care and attention, if the best results are to be achieved.

Attempts to run large numbers of rabbits together have not, so far, proved successful. In enclosed areas things may go fairly well for a year or so, but after that time there seems to be a great risk of some devastating disease attacking and decimating the whole colony. Moreover, under such conditions selection for breeding is a difficult matter. The Morant system—that of running rabbits in moveable pens on grass with a small house attached—has met with a good deal more success, but after maturity is reached both bucks and does, in most varieties at least, develop combative instincts, and this is fatal to the production of good fur. The system also has other drawbacks. On the whole, the hutch method of rabbit-keeping has, so far, proved to be much the most successful, and hutches imply cleaning out and individual attention. Again, the full adult winter coat, reached usually at the age of about 8 months, is undoubtedly the best, though some of the younger skins are also useful for certain purposes. This limits the breeding season, for nearly always (if not indeed always) those rabbits which reach maturity during the summer months have but indifferent pelts, and it can hardly be a paying proposition to keep them till they moult again for the winter months. Time may overcome these difficulties, or some of them, but at present they unquestionably exist.

There is also to be met and overcome the prevailing prejudice against wearing anything known to be rabbit fur. In the view of a writer in one of the trade papers, if rabbit fur ceased to be labelled with fancy names, and were described as rabbit fur, there would be a falling off in trade. Whilst this is a prejudice which is dying out; whilst many ladies of fashion wear our new furs and do not in the least object to their being rabbit furs; whilst some of the biggest and best known London furriers and dressmakers have in fact bought British rabbit furs and paid good prices for them; whilst in Paris some of the leading firms advertise "peau de lapin"—nevertheless, the trade in this country is, to say the least of it, timid in the matter, and prefers to stick to its "coney."

It is also to be borne in mind that though a few thousand skins were sold by the Fur Board last season, this is a mere drop in the bucket. British rabbit furs in natural colours are not yet a regular "line," there is no regular market for them, the supplies being still too small. The Fur Board, therefore, has

to make its own market, and in the absence of large supplies and a large capital expenditure in advertising, this will take time.

Lastly, there is foreign competition to be met. The imported prepared and dyed articles and the small supply of natural rabbit furs imported at present are of inferior quality to our home-produced goods. In respect of quality, there does not appear to be any great danger, but inferior though they be, foreign skins are still bought very largely by the public which, taken as a whole, is not at present very discriminating in this matter.

From every point of view therefore it would seem to be wise to go slowly but steadily forward, avoiding anything in the nature of a big plunge. We have here the makings of a new and prosperous industry. The furs themselves are beautiful things. Their admirers are steadily increasing in number. Do not let us spoil its prospects by trying to go too fast. To put the whole matter in a nut-shell: the advice given here is to keep a few of the very best rabbits and to show their pelts, made-up into wearing apparel, to as many people as possible, and thus advertise by successful examples the value of home-produced rabbit fur.

References to useful literature dealing with rabbit-breeding may be obtained on application to the Ministry.

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IMPORTATION OF CONTINENTAL GOATS.

PERCY A. FRANCIS,
Ministry of Agriculture and Fisheries.

THE importation of goats from the Continent made recently by the British Goat Society, in order to provide fresh blood for goat breeders in this country, was completed on 24th November last, when the imported animals were released from quarantine at Tilbury Docks and handed over to the respective purchasers. This importation, which has now been successfully completed, is the largest ever made into Great Britain, and constitutes perhaps the most valuable of the many efforts made by the British Goat Society to assist the development of goat-keeping in this country. The last importation, which consisted of thirteen goats, was made by the British Goat Society as long ago as 1903, and though the Society made several unsuccessful attempts to import further animals at subsequent periods they were unable, mainly for reasons in connection with precautions enforced by the Ministry of

Agriculture and Fisheries regarding foot-and-mouth disease, to make fresh importations until now.

Goat breeders in Great Britain have consequently been considerably circumscribed in their breeding operations, and many complaints have been heard in recent years regarding sterility and various forms of disease in goats, which, rightly or wrongly, have been attributed by breeders to the effects of in-breeding. That in-breeding has taken place to a considerable degree of late years is apparent if the pedigrees of the best-known strains of goats be examined, and it says much for the skill of British goat breeders, that with such limited material at their disposal they have succeeded in producing a number of goats which in all probability are not inferior as milk producers to any goats in the world. Experienced breeders, however, have long desired to obtain fresh blood, and last spring, owing to the active efforts of Lord Dewar, President of the Society, Mr. Thos. A. Palmer, the Hon. Secretary, and Mr. Herbert Hughes, the well-known Broxbourne breeder, permission was obtained from the Ministry for the Society to import goats from Holland and Switzerland on condition that certificates were produced from the Veterinary Authorities in these countries to show that the districts from which goats were purchased were free from foot-and-mouth disease; and provided the Society found suitable quarantine premises for the goats at the port of entry into Great Britain and isolated the animals for a period to be specified by the Ministry.

The Society informed its members of these conditions and invited applications from members desirous of obtaining an imported animal. Although all applicants were called upon to put up a sum estimated to cover the final cost of an imported goat and to take all risks, a fund of over one thousand pounds was quickly raised, and Messrs. Palmer and Hughes were authorised to proceed to the Continent and to purchase upwards of 50 goats. From Holland, 29 Saanen goats and from Switzerland 17 Toggenburg goats were purchased and brought into quarantine at Tilbury Docks, where for six weeks they were kept under the constant supervision of an officer of the Ministry. The goats appear to have withstood the effects of travel and quarantine remarkably well, and only one died. At the dispersal on the 24th November a few animals which had not been distributed by ballot were put up to auction, and prices varying from £10 to £16 16s. were realised. With one exception these auctioned goats were kids of last spring.

FIG. 1.—Toggenburg Goats in Switzerland—Part of the importation by the British Goat Society.

FIG. 2. Dutch Cross-bred Goats near Middelburg, owned by Peasants

FIG. 3.—Prize-winning Dutch Saanen Goats at Roermond Show, 1921.

FIG. 4.—Young Male Dutch Saanen Goats at the Stud Goat-breeding Centre of the Breda Provincial Goat-breeding Association.

Amongst breeders who obtained animals through the ballot were the Countess Bathurst, Miss Chamberlain, Lord Dewar, and Sir G. H. Fisher-Smith; whilst the Sussex County Goat Club and the West Surrey Goat Club obtained stud goats for the benefit of their respective Club members. The Irish Department of Agriculture purchased three and the United Irishwomen's Association one of the goats. The following table shows the area of distribution:—

Surrey	3	Hants	3
Yorks	8	Glos.	2
Northumberland ...	4	Ireland	4
Monmouth	1	Warwick	2
Lancs.	2	Dorset	1
Sussex	3	Wilts	1
Suffolk	3	Essex	2
Kent	3	Herts	3

Mr. Reginald Pease, Chairman of the Society, when expressing his thanks for the Ministry's co-operation in the importation, also expressed the hope that in the near future an official census of goats such as was taken in Ireland and several continental countries might be taken in Great Britain. He stated that it was in his opinion desirable that the practice of goat-keeping should be further extended amongst cottagers and small holders in the country and that more attention should be paid to developing the utility qualities of British goats.

The Dutch Saanen.—All the imported Saanen goats were purchased in Holland and it is of interest to note that the spread of the Saanen in Holland is a matter of recent years, though now in many Dutch provinces this is practically the only type of goat to be seen. Many importations of Saanens from Switzerland and from Hesse in Germany have been made into Holland and these importations have been encouraged and assisted by the Dutch Ministry of Agriculture, which now makes grants of approximately £1,100 annually towards the development of goat-keeping. The last official census of Dutch goats shows upwards of 300,000 animals, and no doubt the numerous breeding societies, of which there were last year upwards of five hundred and which are closely in touch with the Dutch Ministry—from whom as well as from the Provincial Authorities, the Societies derive financial assistance—are largely responsible for the development of goat-keeping in Holland. In the provinces of North Brabant and Limburg alone there were in 1920 103 Associations including 3,468 members owning 13,600 goats. These members are mainly rural workers and peasant cultiva-

tors who keep goats chiefly as a cheap source of milk supply for their families. This appears to indicate that similar difficulties have been experienced in obtaining retail supplies of cows' milk in rural districts in Holland, as is the case in many such districts in England and Wales. Holland is famous for its herds of dairy cows, which are kept in large numbers under more or less intensive conditions, but this has not prevented the rapid development in Holland of goat-keeping by the peasant and small holder classes.

The Dutch Saanen has not infrequently been crossed with the native Dutch goat, but the white colour of the Swiss Saanen has persisted in the majority of cases. At the Experimental Goat-breeding Station at Seroskerke near Middleburg, which was founded by private enterprise, but now receives support both from Provincial and State Authorities, Mynheer Zwagerman, the Director, has for some years conducted experiments to test the milking qualities of goats possessing varying proportions of the blood of the old native Dutch goat and of the imported Saanen. The native goat in its original form is credited with producing milk of higher quality but less in quantity than that of the imported animal, whilst the former is considered to possess a hardier constitution. M. Zwagerman aims at producing a type of goat more suitable than either, for Dutch conditions, and in the meantime is conducting a herdbook containing unusually detailed particulars of each animal for the goats in the Middleburg district.

A number of the Saanen goats obtained by Messrs. Palmer and Hughes were purchased in the Province of Breda, where the Provincial Goat-Breeding Association maintains a special Stud Goat-Breeding Centre. Messrs. Palmer and Hughes also visited the Province of Drenthe in search of Toggenburgs, but being unsuccessful in finding suitable animals there, they went on to Switzerland, from which country the whole of the imported Toggenburgs were obtained.

Goats in Switzerland.—Although in Switzerland private initiative in goat-breeding is regarded with a helpful and sympathetic attitude by the public authorities, in the main the breeding of Swiss goats is nearly everywhere controlled by Syndicates and Associations, which receive grants from both the Federal and the Canton Authorities. In nearly all Cantons in which goat-breeding is extensively practised, the local goat-breeding associations have united to form Breeding Unions.

In the North and the East Cantons these Unions have united into the "Union of Swiss Goat-Breeding Associations," while in the West the "Syndicat d'élevage du petit bétail du canton de Fribourg" has control of the various organisations. The German-Swiss Union has more than 9,000 members and publishes a Journal called "The Swiss Journal of Small Stock Breeding," whilst the French Union or Syndicate includes some 50 unions as well as separate breeders.

The Goat-Breeding Syndicates, of which there are about 900 in Switzerland, endeavour to facilitate the acquisition by their members of good breeding stock, especially of male animals, the encouragement of proper breeding methods and the keeping of accurate pedigrees. They also assist their members in the disposal of their stock.

In addition to these breeding syndicates there exist associations whose main function is to keep male goats, but which do not attempt to record pedigrees, this being left to the breeding syndicates.

The grants to the syndicates and associations from the Federal and Canton Authorities are partly given towards the general expenses of the organisations and partly as prizes directly for individual animals. The goats owned by the organisations have to be presented for inspection by the local and federal authorities at annual meetings, and the prizes or premiums are often not awarded until the following year, when the animals have to be presented again for inspection and the record of their work considered.

The Federal Authorities have also taken steps to prevent breeding from stud goats of inferior quality and in most of the cantons the males used for such purposes must be examined by an expert committee, and only male goats to which premiums have been awarded or approved may be employed for breeding purposes.

The principal breeds of goats kept in Switzerland are the Saanen, the Toggenburg, the Appenzell, the Chamois Mountain Goat, and the Valaisan Black-necked Goat. Of these breeds the first two are the only ones known to any extent in England.

The Saanen is widely distributed over the western part of Switzerland and is the most common goat kept for dairy purposes. It was first developed in the Saanental and Simmental of the canton of Berne, and these districts still form the headquarters of the breed. As the Saanen is adaptable and thrives

under a wide range of conditions, exports have been made from Switzerland to many countries, and this breed is now found in Holland, Germany, Austria, Serbia, Russia, France and America. The Saanen is usually hornless, of medium size and slender build. The colour is usually pure white and the hair short and thick, though on the males the coat is generally longer than on the females.

The Toggenburg derives its name from the valley of the Toggenburg, in the canton of St. Gall. The breed is also met with in the cantons of Thurgau, Schaffhausen and Zurich, and has also been exported from Switzerland to many countries. The Toggenburg is medium in size, compact in shape and hornless. The colour is light or medium brown with white stripes down the face, white rings round the ears and tail, and white feet. The coat should be short or medium in length.

Both the Toggenburg and the Saanen breeds are considered in Switzerland to be very fecund and to possess good milking qualities. Most of the Swiss Toggenburgs graze the whole summer in mountain pastures, and the hardiness of their constitution is often attributed to this fact.

It is estimated that in Switzerland there are about 350,000 goats, owned by 100,000 goat keepers, most of whom are small cultivators. Some 57 per cent. of the agricultural holdings in Switzerland are less than 5 hectares ($13\frac{1}{8}$ acres) in size. Goats are kept almost entirely for supplying milk for the families of the owners, though a certain amount of the milk is made into small soft cheeses. In many of the high valleys of Switzerland the goat often constitutes the sole source of salted meat in the household. In the cantons of Valais and Grisons, gigots (legs) of goats are smoked and are much esteemed. The fattening of kids is also extensively practised and the meat of these animals is in considerable demand. During the winter months Swiss goats are almost, if not entirely, house-fed, and that the goat is capable of thriving under these intensive conditions is shown by experience in other countries, notably in the case of Holland, where intensive methods of goat-keeping are widely adopted.

* Particulars of goat-breeding in Switzerland have been taken from "The Swiss Breeds of Goats" published by the Committee of Swiss Goat-Breeding Associations, and from a paper read, at the Congress on goat-keeping held in Holland, 1921, by Monsieur B. Collaud, Chief of the Department of Agriculture, Fribourg.

* * * * *

THE TAMWORTH PIG.

SANDERS SPENCER.

THE olden type of Tamworth pig is said to have been more nearly allied in conformation and character to the original or wild hog than any other of our district or local breeds. Its long lean head, its muscular neck and shoulders were admirably suited for delving into the earth for those bulbs and roots which formed its principal food during the winter and early spring, or as soon as the supply of beechnuts, acorns, chestnuts, etc., had become exhausted. Its peculiarly shaped pricked ears, having more the appearance of a fox's lugs than the usually more or less pendant ears of a pig, were evidently so formed that the Tamworth pig in its lair in the forest should be notified of the slightest movement whether due to friend or foe. Its short body with well sprung ribs, strong loin, thick shield and long tusks made it both a powerful and dangerous enemy in the general warfare amongst the wild or semi-wild inhabitants of the vast forests in Staffordshire, Leicestershire and North Northamptonshire, where it was most commonly found.

The forequarters of this rusty-coloured pig were, like those of the buffalo, giraffe and some other wild animals, much more fully developed than the hindquarters, whilst the quality of the bone of this and the other animals mentioned was more similar to that of the thoroughbred horse than to that of the rough-legged horse of the Fen districts. The mode of life with its vast amount of exercise rendered the Tamworth pig very muscular and its carcass thus produced a large proportion of lean to fat meat; consequently, its flesh was highly esteemed when preserved for winter consumption by the residents in the districts mentioned.

The present fashionable type of Tamworth pig is very unlike even the improved Tamworth of half a century ago. At the period named the original pig had been much modernised and improved, the sows were prolific and better mothers, the young pigs were vigorous, grew quickly when of some age, responded readily to good feeding, and when fattened furnished a comparatively short and heavy forequartered carcass of pork of fine quality and flavour.

The introduction about fifty years since of the cold-air chamber system of bacon curing, by which the bacon factories were

enabled to carry on their operations as satisfactorily in the summer as in the winter months, created a demand for a fat pig of quite a different character to the fashionable pig of that period. The short, fat, heavy forequartered pig was found to be totally unsuited for the manufacture of the mild cured bacon so much in demand. The necessity for the heavy salting and the accompanying large proportion of fat in the meat cured in the winter for summer consumption had passed away. The public demanded the middle portion of the side of bacon for breakfast consumption comparatively lean and long, and a small ham with a large share of lean compared with fat. As the proportion of salt-carrying lean meat increased, a much milder system of curing became necessary.

The great change in the system of curing, and the resultant enormous increase in the consumption of breakfast bacon, had the effect of calling renewed attention to the formation of the pigs for slaughter and also to the proportion and quality of the meat on the various portions of the carcass. The demand arose for fat pigs longer in the body, better developed in the hindquarters and lighter in the fore end. It is stated that various measures were tried to render the Tamworth pig more suitable for the purpose of the bacon curer. The most successful of the attempts made is alleged to have been the one adopted at a dairy factory in one of the southern counties, the manager of which imported Tamworth pigs from Staffordshire and mated them with pigs of both the Large and Middle White breeds. The more successful cross proved to be the Large White-Tamworth cross, of which a pair of yelts were exhibited at the 1881 show of the Smithfield Club, when the writer was one of the judges. There was little or no hesitation in placing these yelts at the head of their class and they eventually won the cup offered for the best pen of pigs of any cross. These pigs were of a much paler colour than the Tamworths of that period; their heads were rather shorter, their ears were longer and inclined forward, their shoulders were lighter, their backs longer and their hindquarters more fully developed. Their hams were also longer, flatter and less round. Indeed, save in colour, they were not unlike the bacon type of Large White pig of that period. In conversation with the pigman after the completion of the judging, it was admitted that the yelts were in pig and that after the conclusion of the show they were to form a portion of the breeding herd of the exhibitor. As this was before the formation of a society for the registration of

Photo] [*Sport & General.*

FIG. 1. Tamworth Boar.

Photo] [*Sport & General.*

FIG. 2. Tamworth Sow.

the pedigrees of the rusty-coloured pigs, it is not possible to follow these pigs and their immediate descendants.

Some of the present day breeders of Tamworths affirm their belief that the improvement which has taken place in the form and colour of these pigs has been solely due to continued selection and care in breeding. Experienced breeders know that great changes can be made over a long period of time, but in the matter of the Tamworth pig the change was very great and sudden. It has also been pointed out that one of the great difficulties attending the successful breeding of pigs of the breed is the comparatively limited number of the tribes or families of the breed. This may be due partially to too prompt closing of the herd book after the necessity for the alteration in the form and character of the Tamworth pig had impressed itself upon the minds of the breeders.

Canada appears to be the one Colony or foreign country in which the Tamworth pig has become popular. In the Dominion the red coloured pig has some strong supporters amongst those interested in bacon factories, as it has an exceedingly good effect when crossed on the Poland China and others of the lard type of pig so common on the American continent. In this country we also have had proof of the exceedingly good quality of the pork from the Tamworth pig, as some years since the Wiltshire bacon curers distributed several boars of the breed in those districts from which they drew their supplies of fat pigs. Again, only at the 1922 Dairy Show, bacon from Tamworth pigs competed successfully with that manufactured from pigs of several other breeds. The breeders of Tamworth have greatly improved their pigs of late years in lightening the forequarters and lengthening the back, but further attention to these points and to the shape of the ham might be advantageous, as it is considered that in the future the production of the bacon pig will at least be as important a point to be studied by the pig breeder as that of the pork pig.

The standard of excellence as issued by The National Pig Breeders' Association is as follows:—

Colour.—Golden red hair on a flesh coloured skin, free from black.

Head.—Fairly long, snout moderately long and quite straight, face slightly dished, wide between the ears.

Ears.—Rather long, with fine fringe, carried rigid and inclined slightly forward.

Neck.—Fairly long and muscular, especially in boar.

Chest.—Wide and deep.

Shoulders.—Fine, slanting, and well set

Legs.—Strong and shapely, with plenty of bone and set well outside the body.
Pasterns.—Strong and sloping.
Feet.—Strong and of fair size.
Back.—Long and straight.
Loin.—Strong and broad.
Tail.—Set on high and well tasselled.
Sides.—Long and deep.
Ribs.—Well sprung and extending well up to the flank.
Belly.—Deep, with straight underline.
Flank.—Full and well let down.
Quarters.—Long, wide and straight from hip to tail.
Hams.—Broad and full, well let down to hocks.
Coat.—Abundant, long, straight and fine.
Action.—Firm and free.
Objections.—Black hair, very light or ginger hair, curly coat, coarse mane, black spots on skin, slouch or drooping ears, short or upturned snout, heavy shoulders, wrinkled skin, inbent knees, hollowness at back of shoulders

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MAKING BOXES FOR APPLES.

J. TURNBULL,
Ministry of Agriculture and Fisheries.

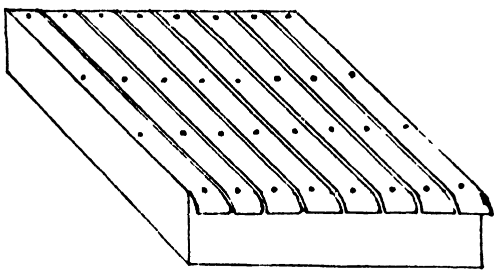
THE time taken in making boxes may be greatly shortened by the use of one or two labour-saving devices. A nail stripper saves much time in picking up nails. Inquiries have been received as to where one could be purchased, but the writer has been unable to ascertain whether they are made in this country. It is, however, a simple matter to make one at home. A nail stripper is a sort of small riddle with a ridge and furrow bottom, with slots in the bottom of the furrow. These slots are of sufficient width to permit the body but not the head of a nail to pass. Nails are put in and shaken as in riddling. The nails drop through the slots until they are held by their heads and remain suspended. The stripper is then hung up in a convenient position and the nails are drawn out from the ends of the slots, all the same way up, as required for use.

The writer first tried one with the ridges and furrows made from sheet tin, but this was difficult to make true and will soon become bent and useless. The following method, however, should prove satisfactory. First make a strong framework—the corners are best dovetailed—about a foot square and 3 in. deep, with wood at least $\frac{3}{4}$ in. thick. Get seven or eight pieces of iron $\frac{1}{16}$ in. thick, $1\frac{1}{2}$ in. wide—cut true—and

$1\frac{1}{2}$ in. longer than the frame. These should be drilled to take screws at each end and in two other places, and the extra $1\frac{1}{2}$ in. should be slightly turned up. Screw these to the bottom of the framework and the outside two to the sides, as shown in Fig. 1, placing them so far apart (about $\frac{1}{8}$ in.) as just to prevent the heads of the nails passing through. At the same time cut notches in the framework above the slots or spaces—large enough to permit the nails to be withdrawn easily—at the end where the turn up is placed. This turn up prevents the nails falling out when riddling.

Then make the ridges of wood long enough to fit inside the framework and of triangular section 1 in. at the base and $\frac{3}{4}$ in. to 1 in. high. Place one of these above and upon each iron slat, so as to be $\frac{1}{4}$ in. from each edge of the metal, and screw together. Half ridges will be required at each side. The exact size of these can be ascertained after the slats have been fixed and should be such as to leave $\frac{1}{4}$ in. between the base of the ridge and the edge of the slat.

1



2

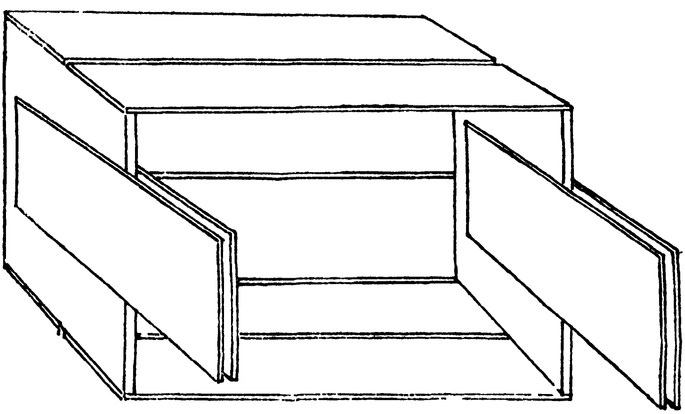


FIG 1.—Nail Stripper; FIG. 2.—Box-Making Device.

Another very simple device for holding the pieces of wood while nailing the box together was shown by an American visitor to the Imperial Fruit Show. A box is made in the ordinary way and two pieces are nailed to the inside and outside of each end in the manner shown in the diagram, so that there is a space equal to the thickness of the ends between each pair. The box is then laid on its side about a foot from the edge of a table and nailed down. (Fig. 2.)

To make a box, two end pieces are placed upright in the spaces between the projecting pieces and against the ends of the made box, so that one of the 10½ in. sides is uppermost. One side is then nailed on. The ends are then turned round, without taking out of the slats, until the nailed-on side is next the maker, and the bottom is nailed on. Another turn, the second side is nailed on, and the box is ready for packing.

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CO-OPERATIVE ASSOCIATIONS IN CANADA.

THE agricultural co-operation movement is of comparatively recent origin in Canada, and its progress is due, amongst other causes, to the active encouragement given to it by the Federal and Provincial Departments of Agriculture and to the conditions arising out of the War. Canada being a comparatively new country, the development of agricultural co-operation has necessarily proceeded on somewhat different lines from those which it follows in older countries. Perhaps the most striking differences are the early application of co-operation to the sale of the staple agricultural products of the country, and the more rapid development of this form of co-operation in comparison with co-operative credit and the co-operative purchase of farm requisites.

Grain.—The grain industry is the most important branch of agriculture in Canada and was the first to which co-operation was applied on a large scale. The chief provinces devoting their energies to grain growing are the three prairie provinces of Manitoba, Saskatchewan and Alberta. In these provinces Grain Growers' Associations and Co-operative Elevator Companies have been formed under Acts of the Provincial Legislatures, and the Governments have made loans in aid of organisation and of the acquisition and erection of elevators up to 85 per cent. of the estimated cost.

In 1920, on the discontinuance of the Canadian Wheat Board, a Wheat Markets Committee representing the provincial farmers and grain growers' associations was formed for the purpose of establishing a wheat marketing agency as a non-profit undertaking, and a draft agreement was drawn up by which it was proposed to bind the growers to deliver to the agency (to be known as the United Farmers' Grain Corporation, with its principal office in Winnipeg) all the wheat grown by them in Canada for five years. The Corporation, on the other hand, was to agree to sell the wheat at the best prices obtainable and to pay the whole amount received less handling, grading and selling charges. The Corporation was to be authorised to establish selling, statistical or other agencies in any city in the world and was to be given power to borrow money on the wheat delivered to it for sale, and to exercise all the rights of ownership without limitation. It was not found possible, however, to bring the scheme into operation in time to deal with the 1921 wheat crop, and at the end of the year the Canadian Council of Agriculture decided not to proceed with the project but to ask the Federal Government to re-appoint the Wheat Board.

Live Stock.—The principal centres of the live stock industry of Canada are the provinces of Quebec, Ontario and Saskatchewan, and it is in these three provinces that the co-operative organisation of shipping, grading, stock-yarding and marketing has been most largely developed. It has also been organised, however, in the Maritime Provinces (Nova Scotia, New Brunswick and Prince Edward Island) and recently an export cattle-pool covering the whole of Canada has been formed by the United Grain Growers, Ltd.

In Ontario the Provincial Department of Agriculture has issued elaborate suggestions, rules and regulations for the co-operative shipping and marketing of live stock in the province, with a model of a shipping statement. In Saskatchewan the first step towards the organisation of co-operative marketing was taken by the local Department of Agriculture, which issued a bulletin in 1913 explaining the method of co-operative marketing and the benefits to be obtained therefrom. As a result, 9 incorporated co-operative stock-marketing associations were formed in 1914, and this number had increased to 54 by 1920, exclusive of the unincorporated branches of the Saskatchewan Grain Growers' Association. To encourage the

organisation of live stock marketing the Co-operative Organisation Branch of the Department supplies each new association, free of charge, with a set of receipts and account forms sufficient to record their marketing for one year, together with a bulletin explaining how the accounts should be kept.

In Quebec several of the sheep breeders' and wool producers' co-operative associations sell sheep co-operatively, their managing secretaries often being the agricultural representatives of the Department of Agriculture. In order to introduce co-operative live stock marketing in the Maritime Provinces, the Dominion Department of Agriculture in 1919 entered into an agreement with the farmers of a district near Bathurst, New Brunswick, to prepare and arrange for the co-operative sale of their sheep in the open market in the autumn of that year. Very good results were obtained from the sale and in the next year the scope of the work was extended to include cattle and hogs.

Following a visit to Great Britain in 1921 of a director and the treasurer of the United Grain Growers, Ltd., to study the live stock marketing conditions, an Export Cattle Pool was formed by the association, under which co-operative shipments were to be collected at country points and sent to Montreal where the accepted cattle would be graded and initial cash payments made according to weight and quality. After grading and payment shippers would be given participation certificates indicating the weight and quality supplied and the amount of cash advanced. Steers, heifers, cows and bulls would then be separately pooled and the gross selling price in each pool, minus cash advances and expenses, would be divided equally amongst contributors on the basis of live weight supplied. The Pool was not formed in time for the 1921 season.

Dairying.—Quebec and Ontario are the two chief dairying provinces. In Quebec a large amount of the co-operative dairying is in the hands of the Quebec Farmers' Central Co-operative Association, all the transactions of which are under the supervision of the Minister of Agriculture, who may take part at meetings of directors, appoint auditors and require the products to be graded by graders appointed by him if the interests of agriculture so require. Besides dairy products the association handles poultry, eggs, live stock, pressed meats, game, wool, vegetables, honey, maple sugar and syrup and farm requisites. The export trade of the association is facilitated by the removal

of restrictions on borrowing powers applied to other co-operative associations.

The co-operative sale of dairy products in Ontario is chiefly undertaken by the United Dairymen Co-operative, Ltd., which acts as the central selling agency for its patrons, either individuals or creameries or cheese factories, whether co-operative or otherwise. At first the company met with strenuous opposition from the local dealers and other interested persons, but it is becoming more and more the central selling agency for local cheese factories and other dairy enterprises.

Co-operative dairying in Prince Edward Island was started in 1891 when the Dominion Commissioner of Dairying visited the island and on behalf of the Dominion Government offered to supply the plant and operate a factory at a fixed charge and to market the butter and cheese, the farmers themselves erecting the necessary buildings. The success of the factory soon led to the formation of other co-operative factories.

In Saskatchewan, following the establishment of the Dairy Branch of the Department of Agriculture, an arrangement was made in 1907 whereby all the co-operative creameries voluntarily placed themselves under the supervision and direction of the Provincial Dairy Commissioner. By this arrangement the Dairy Branch engaged the managers, purchased all supplies, kept the accounts, marketed the produce and paid the patrons.

In Alberta there are about 53 co-operative creameries receiving cream according to grade and selling butter on the grades of the Dairy Commissioner of the Provincial Government. If desired, the Butter Marketing Service of the Department will act as a central selling agency, 250,000 dollars being allotted to the Department with which to make advances on butter sold. This is generally done to the amount of 80 per cent.

Wool.—The co-operative marketing of wool in Canada was started in 1914, and owes its growth almost entirely to the activity and initiative of the Dominion and Provincial Departments of Agriculture. In those early days the Departments supplied expert graders free of charge and undertook to act as central marketing agencies for any associations which might care to sell their wool in this manner. From the first the project was a success, 4 to 8 cents more per pound being obtained than could be secured by non co-operative sellers. It

was not, however, collective marketing alone that brought improvement, but the education of farmers in improving their flocks and wool and in grading and packing their produce for market. In 1917 a great step forward was made by the Dominion Government when it arranged for the proper storage in Toronto of the western wool clip and also negotiated with the banks for advances to wool growers. In 1918 the aim of the Government was achieved when the local associations all over Canada met together and formed their own central marketing association under the name of the Canadian Co-operative Wool Growers, Ltd., with headquarters in Toronto (chosen for its transport facilities and its convenience for the buyers of Great Britain and the United States) and with warehouses and branches in the different provinces of Canada. In 1920 the company marketed the wool of about 12,000 farmers, the amount received being about one-third of the total Canadian clip, of which 51 per cent. was sold to the American trade, 45 per cent. to the Canadian and 4 per cent. to the English.

Eggs and Poultry.—Co-operative marketing of eggs is now being undertaken fairly generally throughout the Dominion. Its development has been made possible by the assistance given by the Dominion Poultry Division, and not only are the amalgamated producers' associations in some instances supplying a considerable proportion of the eggs for local consumption on certain markets, but one co-operative company (the United Farmers' Co-operative Co., Ltd., of Ontario) has become one of the largest exporters in the Dominion. In all, during 1920, rather more than 3,000,000 dozens of eggs were marketed co-operatively.

In Prince Edward Island the main marketing medium is the Co-operative Egg and Poultry Association, the members of which are grouped in separate branches known as Egg and Poultry Selling Associations or "Circles," each of which is designated by a number, the individual members in each circle being likewise designated by numbers which are stamped on their eggs. Each egg circle employs a collector who has charge of the collection of all eggs, ships them to the central candling station (at Charlotte Town, where there is also a poultry killing station and a central hatchery) and apportions the return to the members according to quantity and quality received. The remuneration of the collector may be either by way of salary or commission. The produce is not bought by the Association,

but is consigned to it and sold by the business manager. A stated sum per unit is advanced on all produce received by the Association, some members being paid weekly and some monthly. The balance of the return often provides for all expenses and the reserve fund is distributed to members according to the net value of the produce marketed through the Association. This Association has served as a model for the development of co-operative egg and poultry marketing associations in various other provinces of the Dominion, but in Nova Scotia, where the conditions are different, the Poultry Department of the N.S. Agricultural College undertook to act as a central marketing agency for the local co-operative associations, taking 4 cents per dozen eggs of the proceeds of the sales for the handling and marketing expenses, the balance being paid to the managers of the local associations immediately the eggs were sold. The Department assumed no financial responsibility; it agreed to provide the outlet and assist in organising the circles, all other work devolving on the local managers.

Fruit and Vegetables.—The co-operative marketing of fruit and vegetables is most in evidence in the provinces of Ontario, Nova Scotia and British Columbia. In Ontario, which produces nearly 70 per cent. of the total fruit crop of Canada, there is no central selling organisation, and in recent years the need for the formation of such an organisation has been strongly pressed. In Nova Scotia an Act was passed in 1912 to facilitate the incorporation of Farmers' Fruit, Produce and Warehouses Associations. Under this Act, the United Fruit Companies of Nova Scotia, Ltd., was formed, primarily for the handling of apples. The central company has representatives in Havana and London, these being the two chief markets, and also an intelligence system which keeps them informed every day from all the principal markets. When a big order is received the local companies are notified to have cars ready for shipment on a certain date from the local warehouses, where the fruit is stored and inspected by the company's inspectors to ensure a uniform and high standard.

In 1915 the Annapolis Valley associations subscribed 5,000 barrels of apples for the purpose of an advertising campaign carried out by the Nova Scotia Fruit Growers' Association. In addition, the Provincial Government gave a cash contribution, and an experienced representative was sent to England to advertise Nova Scotia fruit in the principal cities.

In British Columbia an amendment to the Agricultural Associations Act was passed in 1913, whereby duly incorporated associations might secure a Government loan amounting to 80 per cent. of the subscribed capital. The work of these associations was to assemble, grade and pack according to standard rules all fruit and vegetables grown by the respective shareholders, and otherwise to prepare them for market. At the same time a united selling and buying organisation was established under the name of the Okanagan United Growers, which in the first year handled sixty-five per cent. of the crop grown in the district and is now the price-setting factor in British Columbia.

The British Columbia Fruit Growers' Association, working in conjunction with the Provincial Department of Agriculture, advertises the fruit and vegetable products of the province in the markets of Alberta and Saskatchewan. Window cards are distributed free to the dealers, bulletins are inserted in the prairie newspapers, and a free booklet of eighty pages giving recipes and methods of canning is sent to all interested. Circulars referring to the fruits in season are also issued to all retailers every few weeks.

Fruit Preserving.—In 1917 the Ontario Department of Agriculture was instrumental in equipping a small community Canning Centre at Parkhill in which some thousands of pounds of fruit and vegetables and also chickens were canned, and sent to the Canadian Forces during the war. This centre was very successful and resulted in the formation of several other centres in the province. With the cessation of hostilities, however, all the canning centres were disbanded with the exception of that at Parkhill, which is now run as a co-operative community centre.

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A COUNTY DEMONSTRATION FRUIT PLOT AT BEAMINSTER, DORSET.

CHAS. H. OLDHAM,
Ministry of Agriculture and Fisheries.

WITH the object of demonstrating the commercial varieties of fruit most suitable for cultivation under the soil and climatic conditions obtaining in the county, and of providing facilities for instruction in the various manual processes connected with

fruit growing, the Dorset Horticultural Sub-Committee decided in 1919 to establish a fruit plot at Beaminster.

For this purpose an area of approximately one acre of land was leased from the Governors of the Beaminster Grammar School for a term of seven years, at an annual rent of £3. The site is admirably suited for fruit culture. It has natural protection on the east, and the Horticultural Superintendent states that it is unlikely to be affected by late spring frosts. The soil is typical of the district, being a deep loam, with clay subsoil, and is inclined to be on the heavy side. The drainage is natural.

The land, which was down to grass before being taken over, was thoroughly worked and cleaned by deep ploughing, subsoiling, and cross-ploughing. This work was commenced in early autumn, and planting was commenced late in the following January. The top fruit was planted 12 ft. apart in each direction, and the "half standards" staked securely. Since the plot was planted, weather conditions have not been good for young fruit trees in West Dorset, but reasonable growth has been made. Vegetable crops are being grown between the lines until the fruit trees cover the ground.

Top Fruit.—*Apples.*—The varieties of apples planted are:—Bramley's Seedling, Newton Wonder, Lane's Prince Albert, Rival, Cox's Orange Pippin, Allington Pippin, and Worcester Pearmain.

Lanes and Newtons are planted as half-standards, while the rest of the varieties are planted as "bush." Each variety has been worked on the "Paradise" stock, and planted as two-year-olds. The trees are making satisfactory growth, and appear healthy, although at the period of the visit during the late summer "leaf scorch" was seen on a few apple trees, and on Lanes a little "apple canker" was in evidence. All the trees were sprayed with lime-sulphur last February.

Pears.—The district is evidently suitable for commercial pear growing, but the distance from industrial towns would operate disadvantageously. The following sorts appear to be making satisfactory progress:—Beurre d'Amanlis, Conférence, William, Bon Chrétien, and Hessle. They have been worked on the Quince stock.

Plums.—Half-standard plums of Monarch, Czar, Victoria, and River's Early Prolific have been planted, and excellent growth has been made, especially during the past season. A

light crop was removed in 1922, and the trees are in a healthy condition.

Bottom Fruit.—The top fruit has been set in lines running north and south, with two-year-old black currants and raspberries planted between them. The black currants have been planted 6 ft. apart in the rows, and 6 ft. distant from the apple or pear trees. They consist of Booskoop Giant, Carter's Champion, and Seabrook's Black. With the exception of the last, which is showing some reversion, the bushes are doing well.

The raspberries, Hornet and Superlative varieties, are planted 18 in. apart in the rows, and 6 ft. from either row of apples or black currants. Their planting has demonstrated the commercial value of these varieties in the locality.

Nursery Bed.—Several thousand black currants have been propagated in vacant spaces around the plot, as well as apple stocks known as East Malling types 1, 4, 6 and 13. Quince stocks are being propagated with the type A (d'Angers). In due course it is hoped to distribute these types in the county of Dorset, for the benefit of growers who want reliable stocks.

Use of the Plot.—From an educational point of view this county plot may be considered to have already justified its existence, for growers in the neighbourhood visit it continually, and when planting or extending their fruit land inquire of the Horticultural Superintendent the varieties of fruit which are doing well. It has also stimulated an interest in fruit culture in the district.

During the various periods of treatment, demonstrations are arranged at the plot in such subjects as spraying, pruning, grafting and budding. These demonstrations are usually well attended and many questions are dealt with by the instructor. A hive of bees is kept on the plot to demonstrate the value of bees in fruit orchards.

Eventually, if funds are available, it is hoped to erect a shed for the purpose of holding demonstrations in the packing, grading, and storage of fruit.

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NOTES ON MANURES FOR FEBRUARY.

SIR JOHN RUSSELL, D.Sc., F.R.S.,
Rothamsted Experimental Station, Harpenden, Herts.

Accumulated Fertility resulting from the Application of Basic Slag to Grassland.—The East Suffolk results showing the improvement in fertility resulting from the addition of slag to grassland, and recorded in these notes last month, recall the work done by Professor Somerville and reported in this *Journal* (Vol. XXI, Sept., 1914, p. 481, and Vol. XXII, March, 1916, p. 1201). Slagged grassland was broken up and sown with crops, and these were compared with crops grown on some of the same grassland which had received no slag. The experiments were made in pots, and although in general pot experiments would not be considered satisfactory for the solution of an economic problem, we can safely accept Professor Somerville's deductions.

Five crops in all were taken: Oats (1914), two mustard crops (1914), wheat (1915), and mustard (1915). There were two sets of experiments: in one the crops received no further manure beyond what was already in the soil; in the other additional manure was given. Valuing the crops on the soil from unslagged grassland in each set at 100, the following yields were obtained on the soil from the slagged grassland, taken as an average over the whole five crops:—

	No further manure given.	*Manure given.*
Soil from Denton Hill ...	119 ...	108
„ Cockle Park ...	170 ...	150
„ Stoke Talmage ...	102 ...	109
„ Arncot ...	158 ...	143
„ Lees Rest ...	99 ..	102

In three out of the five cases there has been a substantial increase in crops as a result of the previous slagging of the grassland, this of course being additional to the benefits obtained from the slag while the land was under grass.

The Letchworth Bin Refuse.—The Surveyor of the Letchworth Urban District Council sends the following analysis of the bin refuse as it is now available after some reorganisation

of the methods of sorting the refuse, and the new figures are distinctly better than the old*; they are as follows:—

	per cent.
Moisture	28·60
Organic matter	18·93
Residue	52·47
Nitrogen	·62
Equivalent in ammonia	·75
Phosphoric acid	·89
Tri-basic calcium phosphate	1·94
Calcium carbonate	10·44
Oxides of iron and aluminium	7·95

Make the Crop suit the Soil.—One of the best ways of getting the most out of the farm is to find out which crops naturally grow best and to grow them so long as market conditions are favourable. An interesting example of success in this direction is given by some experiments made by Mr. W. E. D. Jones, the Agricultural Organiser of the Pembrokeshire Agricultural Education Committee. Mr. Jones realised that some of the Pembrokeshire districts which were not very successful for ordinary farming by reason of the thinness of the soil, would be eminently suitable for early potatoes. At first sight the conditions do not look favourable for farming; in the case of one farm there were only 3 inches of soil over the solid rock on a large portion of the ground tested, and even where the soil was deepest there were only 6 in. of it. Potatoes were boxed and the treatment was such as to favour early produce; the manuring was good but not excessive, the mixture being:—

3 cwt. superphosphate
2 „ sulphate of ammonia
1 „ sulphate of potash
1 „ steamed bone flour per acre

in addition to farmyard manure which had been applied in the previous autumn.

The crop was ready for lifting early in June while the prices were still high. The first lot raised realised £40 per ton and the last £18; the average for the whole crop being in the one case £21 12s., and in the other £20 per ton. The cost of growing was well below the price realised and a high rate of profit was shown, viz., £73 per acre in one case and £79 13s. in the other. It is not to be supposed that everyone could do as well as this, but the experiment illustrates the well-known fact that a change in the system may often help considerably in improving the finances of the farm by taking advantage of

* See Notes on Manures, this *Journal*, Dec., 1922, p. 839.

some local conditions which particularly favour certain special crops.

Is Phosphatic Manuring necessary for Potatoes?—A correspondent in the eastern counties has sent the results of an experiment made by himself in which superphosphate gave practically no increase in yield, the same result being given by nitrogenous and potassic manuring as by a complete fertiliser, which of course is more expensive. He asks if this is common or if it is wholly exceptional.

At Rothamsted we have recently gone over the whole of the published potato experiments in Great Britain of which we can obtain any account, and we find that out of 178 recorded trials 85 gave no response to phosphates (usually superphosphate) when nitrogenous and potassic fertilisers were present; 28 showed an increase of 10 to 20 per cent. in crop as a result of adding superphosphate and thus making the dressing complete; 47 showed an increase of more than 20 per cent. in crop; and 18 showed a decrease of more than 10 per cent.—in some cases more than 20 per cent. It thus appears that the chances of obtaining a large increase in crop as a result of applying superphosphate to potatoes is only about 1 in 4, but, as against that, the increase when it does come off is valuable. Moreover, there is little, if any, risk of loss: any superphosphate left over by the potatoes remains in the ground and can be utilised by the succeeding corn or other crops.

There is, however, always the possibility that the 18 cases—these being 1 in 10 of the trials—in which the yields were actually depressed by the use of superphosphate may represent some factor which ought to be taken into account in making up a potato manure. The results in question were obtained as a rule on light lands in the eastern and southern counties, chiefly at Bramford, Suffolk, and various Wiltshire centres. Only one case is recorded in the west or north—a light sand in Lancashire. The problem is being studied at Rothamsted. It is well known that superphosphate hastens maturity: this, indeed, is one of its valuable effects on cereal crops; and it may well happen that, in these light dry conditions the crop would have benefited by a longer growing season than the addition of superphosphate has allowed. Support is given to this view by the circumstance that at Bramford the adverse effect of superphosphate was chiefly shown on the unsprayed plots and not on the sprayed plots where the potatoes are kept growing longer.

If further investigation shows this view to be correct it will be possible to amend the formulæ for the manuring of potatoes, by increasing the amount of phosphate when required by the local conditions and decreasing the amount when this constituent is not specially needed.

Prices of Artificial Manures.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	Price per ton				Cost per Unit at London
	Bristol	Hull	L'pool	L'ndn	
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	...	13.15	13. 5	13. 7	17. 3
„ „ Lime (N. 13 per cent.)	...	...	...	11.17	18. 3
Sulphate of Ammonia, ordinary (A. 25¼ per cent.)	15.15*	15.15*	15.15*	15.15*	(N)15. 2
„ „ „ neutral (A. 25¾ per cent.)	16.18*	16.18*	16.18*	16.18*	(N)15.11
Kainit (Pot. 12½ per cent.)	...	..	2.12	2. 0	3. 2
French Kainit (Pot. 14 per cent.)	2. 5	2. 1	...	2. 5	3. 3
Sylvinite (Pot. 20 per cent.)	...	...	...	3. 0	3. 0
Potash Salts (Pot. 30 per cent.)	...	...	..	1. 5	2.10
Muriate of Potash (Pot. 50 per cent.) ...	...	8.15	9. 0	9. 0	3. 7
Sulphate of Potash (Pot. 48 per cent.) ...	...	...	12. 0	12. 0	5. 0
Basic Slag (T.P. 30-32 per cent.)	3.15§	...	...	4· 2§	2. 8
„ „ (T.P. 24-26 per cent.)	..	2.13§	...	...	...
„ „ (T.P. 20-22 per cent)	2.12§	2. 5§	2.15§	2.15§	2. 7
„ „ (T.P. 16-18 per cent.)	2. 2§	...	2. 8§	2.11§	3. 0
Slag Phosphate (T.P. 60 per cent.) ...	6. 7§	...	.	6.15§	2. 3
„ „ (T.P. 50 per cent.) ...	...	...	5.10§	5.15§	2. 4
„ „ (T.P. 40 per cent.) ...	4. 7§	...	...	...	...
Superphosphate (S.P. 35 per cent.) ...	3.17	...	4. 2§	3.12	2. 1
„ (S.P. 30 per cent.) ...	3. 7	3. 0	3.10§	3. 5	2. 2
Bone Meal (T.P. 45 per cent.)	9.10	9.10†	9. 0	9. 0	...
Steamed Bone Flour (T.P. 60 per cent.) ...	8.10†	7.10†	8. 0	7. 7	...
Fish Guano (A. 9-10, T.P. 16-20 per cent.)...	12.15	...	12. 5	12.10	...

Abbreviations: N.=Nitrogen; A.=Ammonia; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ At Goole.

§ Prices include cost of carriage from works to town named. Cost to purchasers in other districts will be greater or less according to the distance of different purchasers from the works.

Importance of proper care of Grassland.—It cannot be too strongly emphasised that grassland needs attention just as surely as does arable land, though not to the same extent. There are cases where nothing more than a dressing of slag is needed, but it is far more usual to find that something else has to be done. Drainage has to be looked to, old drains cleaned or new mole drains laid; some cultivation in the way of harrowing or rolling may be desirable; and various other work is needed. Usually grassland can be improved more easily and cheaply than

any other, but the improvement is not usually effected by simple addition of manure; indeed, it may happen that the manure is almost wasted unless drainage and cultivation receive adequate attention.

A Herefordshire Experimental Farm linked up with Rothamsted.—Mr. E. D. Simon, late Lord Mayor of Manchester, has arranged with the Rothamsted Experimental Station to devote the whole of his farm and dairy herd at Leadon Court, Herefordshire, to a thorough test of the soiling system designed by Mr. J. C. Brown, formerly of the Harper Adams Agricultural College, in which a dairy herd is maintained largely on the produce of the arable land. Mr. Simon has obtained Mr. Brown's services as resident manager, and has authorised the Rothamsted Experimental Station to publish all or any records and accounts that may be deemed helpful to farmers. It is believed that Mr. Brown's system will prove of great value, but in these difficult times the ordinary farmer could not afford to experiment on his own account, and the trial requires more land and dairy cows than could be provided at a College or an Experimental Farm. The experiment will serve a valuable purpose in showing how far the various modifications introduced will be financially advantageous to the dairy farmer, and agriculturists generally will greatly appreciate Mr. Simon's generous action.

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NOTES ON FEEDING STUFFS FOR FEBRUARY.

E. T. HALNAN, M.A., Dip. Agric. (Cantab.),
Ministry of Agriculture and Fisheries.

Feeding Salt to Pigs.—Several correspondents have drawn attention to the fact that salt is generally considered poisonous to pigs, and expressing surprise that it has been included in the mineral mixture quoted in last month's notes. The writer was aware that pigs show slight tolerance only for salt, and for this reason it is very unwise to feed pigs with feeding stuffs known to contain much salt, since salt poisoning is likely to ensue. Like all farm stock, however, pigs need a small amount of salt to keep them in good health, and the experiment quoted in last month's notes supports this view. In the case of excessive

DESCRIPTION.	Price per Qr. s.	Price per Qr. lb.	Price per Cwt. s.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv. s.	Price per lb. Starch Equiv. d.
Wheat, British	44/6	504	9/11	9 18	0 18	9 0	71·6	2/6	1·34
Barley, British Feeding	30/–	400	8/5	8 8	0 14	7 14	71	2/2	1·16
„ American „	31/6	400	8/10	8 17	0 14	8 3	71	2/4	1·25
„ Danubian „	32/–	400	9/–	9 0	0 14	8 6	71	2/4	1·25
Oats, English White	31/6	336	10/6	10 10	0 16	9 14	59·5	3/3	1·74
„ „ Black & Grey	29/–	336	9/8	9 13	0 16	8 17	59·5	3/–	1·61
„ Scotch White	36/–	336	12/–	1 0	0 16	11 4	59·5	3/9	2·01
„ Canadian No. 2 Western	31/6	320	11/–	11 0	0 16	10 4	59·5	3/5	1·83
„ „ No. 3 „	29/6	320	10/4	10 7	0 16	9 11	59·5	3/3	1·74
„ „ Feed	28/6	320	10/–	10 0	0 16	9 4	59·5	3/1	1·65
„ American	28/–	320	9/10	9 17	0 16	9 1	59·5	3/1	1·65
„ Argentine	28/9	320	10/1	10 2	0 16	9 6	59·5	3/2	1·70
Maize, Argentine	39/–	480	9/1	9 2	0 15	8 7	81	2/1	1·12
„ American	38/6	480	9/–	9 0	0 15	8 5	81	2/1	1·12
Beans, English Winter	52/–	532	10/11	10 18	1 17	9 1	67	2/8	1·43
„ Rangoon	—	—	8/6	8 10	1 17	6 13	67	2/–	1·07
Peas, English, Dun	63/–	504	14/–	14 0	1 13	12 7	69	3/7	1·92
„ „ Maple	90/–	504	20/–	20 0	1 13	18 7	69	5/4	2·86
Rye, Home-grown	33/–	504	7/4	7 7	0 18	6 9	71·6	1/10	0·98
Millers' offals—									
Bran, British	—	—	—	7 0	1 11	5 9	45	2/5	1·29
„ Broad	—	—	—	8 5	1 11	6 14	45	3/–	1·61
Fine middlings (Imported)	—	—	—	8 17	1 6	7 11	72	2/1	1·12
Coarse middlings (British)	—	—	—	7 15	1 6	6 9	64	2/–	1·07
Pollards (Imported)	—	—	—	7 0	1 11	5 9	60	1/10	0·98
Barley Meal	—	—	—	10 12	0 14	9 18	71	2/9	1·47
Maize „	—	—	—	10 10	0 15	9 15	81	2/5	1·29
„ Germ Meal	—	—	—	10 10	1 2	9 8	85·3	2/2	1·16
„ Gluten-feed	—	—	—	9 5	1 12	7 13	75·6	1/10	0·98
Locust Bean Meal	—	—	—	8 0	0 11	7 9	71·4	2/1	1·12
Bean Meal	—	—	—	13 0	1 17	11 3	67	3/4	1·78
Fish „	—	—	—	15 10	5 1	10 9	53	3/11	2·10
Linseed	—	—	—	20 5	1 16	18 9	119	3/1	1·65
„ Cake, English (9°/$_o$ oil)	—	—	—	13 15	2 4	11 11	74	3/1	1·65
Soya Bean Cake (6% oil)	—	—	—	12 5	3 2	9 3	69·1	2/8	1·43
Cottonseed „ English (5°/$_o$ oil)	—		—	7 15	2 0	5 15	42	2/9	1·47
„ „ Egyptian (5°/$_o$ oil)	—	—	—	7 12	2 0	5 12	42	2/8	1·43
Coconut Cake (6°/$_o$ oil)	—	—		9 2	1 15	7 7	73	2/–	1·07
Ground-nut Cake (7°/$_o$ „)	—	—	—	10 10	2 2	8 8	56 8	2/11	1·56
Decorticated Ground-nut Cake (9°/$_o$ oil)	—	—	—	13 0	3 5	9 15	73	2/8	1·43
Palm Kernel Cake (6°/$_o$ oil)	—	—	—	7 0†	1 7	5 13	75	1/6	0·80
„ „ Meal (2°/$_o$ „)	—	—		6 17	1 8	5 9	71·3	1/6	0·80
Feeding Treacle	—	—	—	4 10	0 9	4 1	51	1/7	0·85
Brewers' grains, dried, ale	—	—	—	7 17	1 8	6 9	49	2/8	1·43
„ „ „ porter	—	—	—	7 7	1 8	5 19	49	2/5	1·29
„ „ wet, ale	—	—	—	1 10	0 11	0 19	15	1/3	0·67
„ „ wet, porter	—	—	—	1 6	0 11	0 15	15	1/–	0·54

† At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of December and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose coconut cake is offered locally at £10 per ton. Its manurial value is £1 15s. per ton. The food value per ton is therefore £8 5s. per ton. Dividing this figure by 73, the starch equivalent of coconut cake as given in the table, the cost per unit of starch equivalent is 2s. 3d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·21d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

salt feeding, the first symptoms in the pig are a general reddening of the skin, so that any possible trouble can be detected before it develops to a large extent.

Rationing of Dairy Cows.—A leaflet on the feeding of cows* has just been issued by the Ministry, and is of special value to stock keepers since it deals fully with the rationing of cows in accordance with the milk yield. In the production of milk, the dairy farmer's aim is to obtain, not the maximum amount of milk that the cows will give, but the maximum amount of milk consistent with economy in feeding. Thus, with heavy feeding, it may be possible to push a 2½-gallon cow to the stage of yielding 2¾ gallons, but the process is not always economic since the last ¼ gallon may require more food than the financial return from this ¼ gallon justifies. For this reason, the writer advocates the following method of feeding according to milk yield.

The maintenance ration for the herd is drawn up in accordance with the rules given in the leaflet, the quantities of roots, straw, chaff, etc., fed depending on the amount of home-grown food available. Suitable mixtures of feeding stuffs (*see* Leaflet) are then used for every extra gallon of milk yielded. By using a suitable measure it is possible to ration every individual cow, but where for any reason it is impossible to do this, then the herd should be rationed according to the total milk yield, allowing the cowman to exercise his discretion as to individual variations in feeding.

FARM VALUES.	Value per Ton on Farm. £ s.	Manurial Value per Ton. £ s.	Food Value per Ton. £ s.	Starch Equivalent per 100 lb.	Value per unit S.E. s. d.	Market Value per lb. S.E. d.
Wheat	8 7	0 18	7 9	71·6	2/1	1·12
Oats	7 0	0 16	6 4	59·5	2/1	1·12
Barley	8 2	0 14	7 8	71·0	2/1	1·12
Potatoes	2 2	0 1	1 18	18·0	2/1	1·12
Swedes	0 18	0 3	0 15	7·0	2/1	1·12
Mangolds	0 16	0 3	0 13	6·0	2/1	1·12
Good Meadow Hay	4 19	0 16	4 3	31·0	2/8	1·43
Good Oat Straw	2 13	0 8	2 5	17·0	2/8	1·43
Good Clover Hay	5 8	1 5	4 5	32·0	2/8	1·43
Vetch and Oat Silage	2 2	0 8	1 14	14·0	2/5	1·28

If, after having checked the rations by the scientific standards, it is found that the cows are putting on flesh or falling off in condition, the *maintenance rations* should be adjusted until the correct conditions obtain. Extra cake can then be added in excess of the milk requirements, and if the extra yield of milk

* Leaflet No. 388 (*The Feeding of Dairy Cows*).

is worth more than the cost of the cake added, more cake can be added the following week until the point is arrived at where the addition of extra cake is no longer remunerative. By this means the cows are rationed on a strictly economic basis and every 1 lb. of cake fed justifies itself in an increased return in the form of milk.

* * * * * *

Bunt and Smut in Seed Corn.

AN important inquiry is in progress at the National Institute of Agricultural Botany, Cambridge, into the degree of prevalence of bunt and smut in seed corn. A special research grant of £100 was made to the Institute by the Development Commissioners for the purpose of carrying on this work during March-September, 1922, The seed examined was taken from the large number of samples of cereals received at the Official Seed Testing Station.

So far as wheat is concerned the inquiry for this season is complete, and the results show that of a thousand samples, chosen so as to be as representative as possible of the whole country, no fewer than 41 per cent. were contaminated with bunt. In other words, it may be assumed that 41 per cent. of seed wheat reaches the farmer infected with bunt, and what makes the position more serious is that the presence of the disease is not, in most cases, to be suspected from the appearance of the sample. A further point of interest which this inquiry has brought out is that while, judging from the samples examined, no sort of wheat is free from disease, the newer sorts, which have been in cultivation a shorter time, show a smaller percentage of infected samples than the older, which have been grown over longer periods. Again, just as no sort of wheat can boast immunity, so no district in the country can claim to be reasonably free from the disease.

As regards barley, the investigation has not gone far enough to allow definite conclusions being drawn. At present the indications are that some 15-20 per cent. of the samples are infected with spores of the covered smut (*Ustilago hordei*).

The situation thus revealed is sufficiently serious to warrant an urgent call for vigilance and care, and farmers are especially warned to take steps in good time before spring sowing for the treatment of seed corn as prescribed in the Ministry's Leaflets Nos. 92 (*Bunt and Smut in Wheat*) and 328 (*Smut in Oats and Barley*).*

* See also this *Journal*, November, 1922, p. 722.

THE following note has been contributed by Mr. W. L. Williams, as giving the impressions of a consumer visiting the last Fruit Show:—

The Imperial Fruit Show, 1922.

As an exhibition of fruit the show must be regarded as a convincing success reflecting the highest credit upon those responsible for organising it and carrying it through. Personally it was a revelation. I had no idea that fruit of such quality and variety was producible in this country. I had always believed that in fruit production we were miles behind overseas growers, within or without the Empire—that just as in some branches of industry, *e.g.*, the cotton-textile, we were unapproachable by any competitor owing to local conditions, climatic and technical, so in the domain of agriculture whilst we had a certain supremacy in some departments, *in fruit* we were hopelessly outclassed!

I have been under the necessity of revising my judgment. *We really can grow fruit*, and, if I may particularise, we can grow what I regard as the most exquisite in its appeal to the palate—*i.e.*, apples—as well as any growers in the Empire, which means as well as any in the world. I was immensely uplifted by this discovery. Of course, I ought to have known it before, but I was always told that the best fruit was imported—that even the best apples were from abroad. How could I contradict so emphatic a statement? I was born, brought up, and had all my life lived in towns, amid bricks and mortar, knowing little or nothing of trees and flowers and fruits, only knowing that some fruits appealed to me immensely and that others, strawberries to wit, gave me indigestion. Yet I must confess that the only crop I was interested in and anxious about was the apple crop. Was it good? Then I should get unlimited apples at reasonable prices—home-grown with true English flavour which at its best is beyond all doubt the most exquisite of any fruit grown anywhere. That is the kind of consumer I am—very ignorant, but very appreciative of the best and quite content to get it when I can. Thanks to those who urged me to drop politics for a few hours to come out to the Crystal Palace and learn something really valuable, I have a new idea of what the best actually is. I take off my hat to British fruit growers and tender them abject apologies for my ignorance of their achievements.

Having said that, may I be allowed to say a word or two in extenuation of my offence? As I strolled through the show and saw the exhibits—apples, pears, grapes, tomatoes, in baskets,

boxes and barrels, grown in England and Ireland (are Wales and Scotland fruitless?) and graded, packed and displayed to the very utmost advantage, to put them before the public as fruit ought to be put, thus commanding the highest possible prices—I reflected how few of my countrymen ever see fruit under such alluring conditions.

May I remind British fruit growers that the bulk of the fruit they grow is only seen by consumers in a state which is the reverse of attractive. Heaped up in forbidding masses in shop windows or on barrows—good, bad, and indifferent, mixed inextricably—is it any wonder that fruit buying is not popular and a fruit diet so limited and infrequent, that for one household—my own for example—whose meat bill is contemptible but whose fruit and vegetable bill is considerable, there are a thousand where fruit rarely enters.

Economists and captains of industry are looking for new markets, which are hard to find. It may be suggested to fruit growers that their new markets are at their doors, *i.e.*, the crowded area of our own land, and that these can be exploited to the financial advantage of producers and the bodily advantage of consumers.

Has the time not come for a break-away from ancient customs and outworn methods, not on the part of a few but on the part of all fruit growers? Let me as a mere consumer suggest :—

(1) That fruit be no longer despatched from the place of growth in bulk as it is picked but carefully graded and packed. Fruit so treated travels better, is less damaged, and commands higher prices in the open markets. Retailers, I understand, grade the fruit they have bought in bulk, but neither producer nor consumer secures any financial benefit from this process.

(2) That co-operation be more generally employed in collection and distribution. What can be accomplished has been demonstrated with other produce by the small cultivators in Holland and Denmark. Costs have been cut and production made into a profitable business proposition. We have recently heard and read of almost incredible losses by fruit growers in disposing of their produce. Why should this be the case? The consumer pays a sufficiently high price for fruit, even the commonest, to present handsome profits to the producer. In co-operation lies the solution of the problems of fruit growers. Meanwhile the mere consumer is paying top prices for inferior fruit—inferior, that is, in quality compared with price.

(3) That steps be taken to improve qualitatively fruit production. I left the exhibition with a picture glowing in my memory —a riot of colour and beauty of form—unforgettable. Within a few minutes I came across a fruiterer's shop with a display of apples, pears, etc., in the window—C.3. fruit, dirty and repulsive. Its condition was, of course, the shopkeeper's fault, but it was never good fruit—it was just the average fruit that gets into the average shop for consumption by the average citizen. Can anyone be surprised that we are not fruit lovers? It may be too much to ask all growers to reach the high standard of exhibitors, but the mass of growers might easily improve the quality of their fruit. Till they do so their industry must always be an unprofitable one.

Finally, it is worth noticing that modern hygiene emphasises the value of fruit as an article of diet. It is up to fruit growers to justify the claims of dietists. The Imperial Fruit Show sets the standard below which no wise grower will fall.

* * * * * *

Colorado Potato Beetle in France.

ONCE again the Colorado Beetle* has obtained a foothold in Europe, a very considerable area (stated to be about 95 square miles) in the neighbourhood of Bordeaux having been found to be infested. This outbreak, taking into account the large area involved, is the most serious which has yet occurred outside the American continent, and its relative proximity to Britain increases considerably the risk of the introduction of this dangerous pest into this country.

So long ago as 1877 Europe became greatly concerned at the possible havoc which might result if the Colorado Beetle were to become established, and it did in fact effect temporary settlements in Germany in 1877, 1887 and 1914, and in England in 1901. The fact that these invasions were in each case completely stamped out has given rise to the impression that the beetle is not the dangerous enemy it was at first represented to be. There is, however, little real ground for this optimistic point of view—in each of the previously recorded outbreaks the beetles bred freely, and at Tilbury in 1901-2 it was proved that they could withstand the English winter climate. The Bordeaux outbreak is suggested, with some reason, as being of two years' standing, and taking this into account with the large area involved it would seem impossible to assert that European conditions are unsuitable to the insect. All the evidence available therefore points to

* Leaflet No. 71 (*Colorado Beetle*) gives an illustrated description of the insect and measures for its control.

the possibility of the beetle establishing itself rather than to the reverse.

This being so, the next point of importance is the nature of the loss which the insect might cause in Great Britain, and here American experience alone is available as a guide. It would appear that in the United States of America the insect is now kept well under control and the losses which it causes in that country may be considered as confined to the expense of the necessary treatment, which consists in spraying the crops at least twice with an arsenical wash such as lead arsenate or Paris green. The same treatment would doubtless be effective in Britain, and growers can therefore estimate the losses to be anticipated from the introduction of the Colorado Beetle as the cost of spraying the crop with lead arsenate, etc., twice a year. This measure, though sufficient to prevent further loss, is unlikely ever to extirpate the pest, and it would therefore have to be accepted as part of the normal routine of potato growing.

It is clear from what has been said above that such measures as are possible should be taken to prevent the introduction of the beetle. In order to realise how far any measures are likely to be successful it is necessary to recall its habits. The great majority of the insects spend the winter as adult beetles in the soil, less frequently in rubbish, while a few may also winter as pupæ, likewise under the soil. In the spring the beetles come out and pair, and the females fly in search of potato crops on which to feed and lay their eggs. If they are unlucky in their search (and they can exist some time without food) they may fly considerable distances, but certainly not so far as from Bordeaux to Britain. They also feed and lay eggs on plants related to the potato, such as the tomato or the egg plant, and even on various unrelated weeds, but it does not seem that they can live for long on the latter. The eggs hatch into grubs which feed upon the potato foliage and are able to crawl from leaf to leaf or plant to plant but are incapable of travelling far enough to invade fresh territory. When full fed the grubs burrow in the soil, change to pupæ, and then to the adult beetles. In America there appear usually to be two generations in the summer, the adult beetles of the second generation burying themselves in the soil at the onset of cold weather.

From this account of the habits of the pest, it is clearly the adult winged beetles which are to be feared, since their capability of movement enables them (1) to fly on board ships or to crawl into packages, and (2) on arrival in a new country to fly con-

siderable distances in search of potato crops. By far the most likely time for this to happen is in the spring, when the beetles may appear before the potato tops are "through," and in consequence the females may be forced to fly a distance to find their food. The same might occur in summer or early autumn, but it is very much less likely, as in summer abundant food will be available and in autumn the beetles are seeking their winter quarters in the soil. Applying this to the French outbreak it is clearly impossible to take such measures as would prevent all risks, since it would necessitate a complete embargo on shipping from Bordeaux (to say nothing of the North American continent).

The utmost that can be done is to prohibit the type of import most likely to carry beetles, that is to say, the actual produce of the land in the infested territory. Consignments of such produce, and notably of course potatoes, being packed on farms and nurseries where the beetles actually occur may, with certain obvious exceptions such as wine or seeds, be considered the most dangerous type of import and their prohibition would result in a definite reduction of the risks which Britain must run. The embargo should be most effective next spring and early summer, but there are some grounds for putting it into operation at once since it is known that the beetles occasionally winter in places other than under the earth, while living plants imported with soil round their roots might also carry the insects.

A more difficult question to decide was the area in France which should be regarded as possibly infested. If it be accepted that the beetle has been in France for two years, there is a chance that the full range of infested territory may not yet be known, and to meet this contingency some indication of the probable maximum spread may be obtained as follows. When the beetle first became a pest in America it spread across the continent from west to east, the boundary of the infested area advancing at an average rate of 88 miles per year. In the north-eastern States, however, the spread appears to have been more rapid, reaching approximately 100 miles per year, possibly on account of the greater frequency of potato crops or of the better development of transport by which beetles might be carried. Assuming that the conditions in France correspond with those most favourable to the spread of the insect in America, which is perhaps hardly likely, the maximum area to have become infested would be that within a 200-mile radius of Bordeaux. The inclusion of such an area has actually been decided

upon, in connection with a restrictive Order under the Destructive Insects and Pests Acts, of which a summary is given on p. 1060. These restrictions will contrive such safeguards as are possible, but it must not be thought that they will remove all danger Individual beetles may arrive at any time by means which no restrictions can prevent, and it is therefore of great importance that potato growers should warn the Ministry if they discover suspicious insects on their crops. A further statement as to the exact appearance of the pest in its different stages will be issued before the spring, when the beetles if present would make their appearance.

* * * * * *

REPLIES TO CORRESPONDENTS.

Soil Burning.—E.F. asks for information as to burning soil for agricultural purposes.

Reply: There are two distinct processes which may be referred to as soil burning :—(1) Clay burning, in order, as is stated in the Standard Cyclopædia of Agriculture, "to mitigate the retentive character of the soil by introducing into it a mass of material deprived of adhesive properties through the action of heat"; and (2) the process of paring and burning. Both processes have fallen more or less into desuetude but the former is still practised in road and railway engineering.

Dried Yeast for Feeding Purposes.—L.M. asks whether he should feed dried yeast to pigs for the sake of the vitamines; and O.P. also asks for information as to dried yeast as a feeding stuff.

Reply to L.M.: A mixed ration will generally contain all the vitamines the pig requires. There are three vitamines, A, B and C. A is present in cod-liver oil; B in whole grain or milling offals such as middlings and bran; C in roots. Green food such as cabbages, &c., contain all three. Yeast is rich in vitamine B, but it is not necessary to include it in a ration containing milling offals such as bran and good middlings.

Reply to O.P.: Articles on the subject appeared on page 1 of the April, 1915, number of this *Journal*, and in the Fertilizer and Feeding Stuffs Journal for 11th October, 1922. Yeast should not be included in any rations containing substances of a sugary nature such as molasses, chocolate powder or milk powder.

Willow Canker.—We are advised by clients of ours that their willows are infested with canker . . . . we shall esteem it a favour if you will advise us of a remedy.

Reply: The willows are affected with Willow Canker caused by the fungus *Botryosphæria gregaria*, described on page 10 of Leaflet No. 301.

It is found that the canker often occurs at the base of the rods, and unless these are cut off close to the old wood each year, canker patches may liberate spores in spring and summer which infect the new rods. It is highly important, therefore, to cut the rods right back. If this has not been done it

would pay to go over the beds again and cut the spurs back and collect or plough in the pieces cut off.

Bitter Rot of Apples.—Will you be good enough to let me know the disease apparent in the two apples sent herewith, and also the remedy to be adopted to cure it?

Reply: The apples are affected with Bitter Rot (*Glomerella cingulata*), a disease that is more common in the United States, but which does occur fairly frequently in England. The brown depressions bear a number of pink pustules, with the spores on them in pink masses. The flesh under the brown spot is said to have a bitter taste, hence the name. The rot extends until the whole apple may be involved. There is also occasionally a canker on the wood caused by the fungus, and in the spring the pink pustules appear on the depressed area of the bark.

Diseased fruit should be collected and burnt and all cankers and cankered boughs cut out. Spraying with Bordeaux Mixture as for Scab will control the disease, the most important spraying being that given about six weeks after the petals have fallen.

Mealy Bugs.—Would you let me know if there would be any harm in washing the vine rods in winter with spirits of wine?

Reply: In reply to your inquiry, the Ministry has no leaflet dealing with Mealy Bug. There would, however, be no harm in sponging the rods with spirits of wine in winter after they had been scraped as you suggest—in fact methylated spirit, which is cheaper, is one of the remedies recommended for the control of this pest.

Disease on Apple Trees.—Will you kindly inform me what the two diseases of these two apple tree specimens are?

Reply: The black objects on the apple twig are eggs of an Aphis (*Aphis pomi*). For these, spraying the tree thoroughly with lime-wash in the spring, so that all boughs and terminal shoots are well covered by the mixture, would possibly be found to be the most effective method of dealing with the pest. The operation might be undertaken in March. The enclosed Leaflet on the subject gives the formula for lime-wash.

There is also a slight amount of Mussel Scale present, upon which a Leaflet giving some information as to the pest and some suggestions for control is also enclosed.

Capsid Bugs.—Capsid Bugs appear to have done considerable damage to apples during the present season. Have you any information or suggestions for combating this pest beyond those contained in the Ministry's Leaflet on the subject, please?

Reply: As to your inquiry concerning Capsid attack on apples, there has been no notable advance in regard to the general nature of the treatment to be advised since the issue of the Ministry's Leaflet. The one point which has become more obvious is that sufficient attention is not as a rule paid to the technique of spraying. Large quantities of expensive washes, such as nicotine, are often used, but comparatively little attention is paid to ensuring their application in such a manner as to produce the best results. In the case of Capsid spraying, success is almost wholly dependent on very thorough work—to such an extent that of two growers, both using the same wash on the same day, one may obtain a 90 per cent. control and the other little commercial result for his work.

Weevils Infecting Malting Houses and Stores.—Under separate cover we are sending you a sample of the weevils infesting our malting houses and stores and we should be glad to have your report on the matter.

Reply : There were various species of weevils and beetles in your enclosure, some of them definitely harmful and others following the depredations of the rest. Among those sent were *Silvanus surinamensis*, *Calandra granaria* (the Grain Weevil), *Ptinus fur*, *Palorus* spp., and Mealworms (the larvæ of *Tenebrio molitor*), together with one or two smaller larvæ of other species not yet definitely determined. The enclosed Leaflet on hydrocyanic acid gas fumigation will give the needful particulars of this method of treatment. Needless to say the store should be cleared and very thoroughly cleaned down.

Where feasible raising the heat of the store to a temperature of approximately 130°F. should destroy the whole of the insect population therein. A little lower temperature has been found effective for some species but some are more resistant than others and therefore the higher temperature would be preferable.

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World's Dairy Congress, 1923.

THE following circular letter has been addressed by the Secretary of the World's Dairy Congress Committee for England and Wales to County Councils, County Borough Councils, and Associations and other Bodies interested in the various aspects of the dairying and milk industry in England and Wales :—

1. As you are aware, the United States of America will hold an international dairy meeting in October, 1923, under the title of the World's Dairy Congress. The initiative was taken by the United States Government, through its Department of Agriculture, in getting the movement under way. The plan was taken up with enthusiasm by those interested in dairying and dairy products, and arising therefrom the World's Dairy-Congress Association was formed. This organisation will conduct the Congress with the co-operation of the United States Department of Agriculture, and the International Dairy Federation will also co-operate.

2. The Congress will be a gathering together of representatives from many nations for the purpose of seeing and hearing about the latest advances made in the field of dairying. It is believed that the Congress will be of great value to all participating countries, both from a scientific and commercial standpoint, by bringing together the leading men of scientific and commercial experience for the consideration of all the larger problems involved, with a view to making available the best information in existence concerning the importance of milk to the consumer, as well as the most effective and economic method of production, distribution and regulation.

3. Four main groups of interests are concerned, viz., those connected with :—

(*a*) *Research and Education*, e.g., teachers, investigators, engineers and other technical men interested in the solution of dairy problems.

(*b*) *Industry and Economics*, e.g., men engaged in the business of production, manufacture, export, import, storage and distribution of dairy animals, products and equipment.

(*c*) *Regulation and Control*, e.g., state, county, municipal and private officials concerned with standards, adulterations, sanitation and disease control.

(*d*) *National Health*, e.g., public health and nutrition workers, philanthropists, welfare workers and students of the influence of diet on the health and vigour of the nation.

4. The National Dairy Association will hold its annual Exposition immediately following the Congress and in the same City. This Exposition brings together a thousand or more of the best-bred cattle of the United States and Canada, while its mechanical exhibits occupy several hundred thousand square feet of floor space. The United States Government, the Universities and Agricultural Colleges have scientific and educational exhibits at the Exposition.

5. The Ministry of Agriculture and Fisheries and the Ministry of Health were approached, through the Foreign Office, by the United States Government, and also directly by the Congress Association, on the subject of the representation of this country at the Congress. The Ministries are in full sympathy with the objects of the Congress and are prepared to accord a full measure of support to an effort to arrange for an adequate representation at the Congress of the dairying interests—educational, commercial and hygienic—in England and Wales. With this object a World's Dairy Congress Committee has been constituted for the purpose of organising this representation and of acting as a connecting link between the Congress Association and the dairying (including "public health") industry in this country. The Committee includes representatives of Government Departments, of public health bodies, and of the various interests, educational and commercial, concerned with the dairying industry.

6. At their first meeting, held on the 19th instant, the Committee elected as their Chairman, Sir Daniel Hall, Chief Scientific Adviser of the Ministry of Agriculture, and as Deputy Chairman, Sir Douglas Newton, M.P. An officer of the Ministry of Agriculture was also deputed to act as Secretary to the Committee.*

7. Action by the Committee in securing the representation of England and Wales at the Congress must be taken in two main directions:—

(*a*) Selecting a body of delegates to attend the Congress.

(*b*) Arranging for suitable papers to be read at the Congress.

8. *Selection of Delegates.*—It is probable that apart from any action taken by the Committee, certain bodies may desire to send representatives to the Congress, and to pay their expenses. There may also be individuals prominently identified with the industry who may be sufficiently interested to attend the Congress at their own expense. On the other hand, it is very probable that if the persons attending from this country are limited to those who are willing to pay their own expenses, or whose expenses are paid by an Association, adequate representation of England and Wales will not be secured. ***For this reason the Committee desire to appeal for funds which would enable them to "fill the gaps," that is, to send to America such persons, who cannot be expected to pay their own expenses, as to ensure that every important aspect of the dairying industry in this country is represented in the delegation which ultimately travels to America.***

9. I am therefore instructed by the Committee to enquire:—

(*a*) Whether your   intend to send a representative to the Congress at their own, or his own, expense?

* Mr. V. E. Wilkins, B.Sc.

(*b*) Failing that, whether your   will be prepared to contribute towards the Fund, to be administered by the Committee, from which will be paid the expenses of such representatives as are considered necessary to complete the delegation?

The Committee earnestly trust that such a contribution will be made, and further, that in view of the considerable sum required, the contribution will be a substantial one. Contributions which individual members of your   may care to make towards the Fund will be appreciated.

The Committee have appointed Mr. J. F. Blackshaw, O.B.E., the Ministry's Dairy Commissioner, to be Honorary Treasurer of the Fund. Cheques should be made payable to the "World's Dairy Congress Committee," and crossed *London County Westminster and Parr's Bank Ltd. (Charing Cross Branch).*

10. *Papers.*—The Committee would be glad to receive suggestions from your   of the names (and addresses) of persons who might be invited to write papers for the Congress, with the subjects on which they would be qualified to write. Normally, papers will be written by persons who will be able to read them at the Congress, but the Committee are prepared in special cases to consider the offer of papers by those who are unable to attend. Papers of general rather than local application are desired. The Committee especially wish to receive papers dealing with *new achievements* in any branch of the dairy industry, and noteworthy advances in the sciences relative to dairying. Methods which have been found in any country to be of marked value in increasing production, lowering costs, stimulating consumption, and improving national health should be reported.

11. Finally, I am to call attention to the fact that the matter is most urgent for two reasons:—(*a*) Papers have to be in the hands of the United States authorities not later than 1st April next. (*b*) The selection of delegates must be made as soon as possible, in order that negotiations for special steamship rates may be opened and bookings fixed up.

I am therefore to ask that your   will be good enough to give this matter their very earliest consideration and notify me of the decision arrived at.

* * * * * *

Colorado Beetle Order, 1922.—In consequence of the infestation of potato crops in the area around Bordeaux (France), dealt with above, an Order has been made by the Ministry under the Destructive Insects and Pests Acts restricting the importation of any living plants and vegetables from France. The Order, which came into operation on 1st February, 1923, prohibits the landing in England and Wales of any living plants or vegetables from any port in France (but not Algeria) unless (1) the landing is authorised by a licence issued by an Inspector of the Ministry, or (2) they are accompanied by a declaration in a form prescribed by the Order.

This declaration, signed by the grower or exporter, states that the consignment was not grown in the following Departments of France:—Gironde, Landes, Basses Pyrénées, Haute Pyrénées, Haute Garonne, Ariège, Aude, Gers, Tarn, Lot-et-Garonne, Tarn-et-Garonne, Aveyron, Lot, Dordogne, Corrèze, Cantal, Puy de Dôme, Creuse, Haute Vienne, Charente, Charente Inférieure, Indre, Vienne, Deux Sèvres, Vendée, Loire Inférieure, Maine-et-Loire, Indre-et-Loire, Lozère.

Any consignment landed without such a licence or declaration will be destroyed unless it is authorised to be disposed of otherwise by a licence issued by an Inspector of the Ministry.

"Living plants or vegetables" means trees and shrubs, tubers, bulbs and flower roots, raw vegetables including potatoes, potato haulms and leaves, and tomatoes.

A copy of the Order can be obtained from the Ministry, 10, Whitehall Place, S.W.1.

Foot-and-Mouth Disease.—One further outbreak has been confirmed in the Cheshire area since the date (18th December) referred to in the note contained on pp. 958-9 of the *Journal* for January, namely, on 23rd December, on premises at Mickle Trafford, in the vicinity of one of the previous cases. No other development having occurred, the restrictions have been withdrawn except from small areas in the immediate neighbourhood of the several infected premises.

On the 30th December, a new centre of disease was brought to light by the confirmation of disease at Ferndale in the Rhondda Valley of Glamorgan, eleven cattle on the premises being found affected. The position was somewhat disquieting inasmuch as the owner had a number of sheep grazing near the infected sheds which had access to a mountain on which approximately 2,000 sheep were running. As a matter of precaution 175 sheep which were regarded as having been in close proximity to the infected sheds were slaughtered and special arrangements were made for close observation to be maintained in respect of the remaining sheep. Fortunately, there has been no further development and it has been found possible to remove the restrictions from the outer portions of the area to which the usual standstill Order was applied.

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NOTICES OF BOOKS.

The Law of Allotments and Allotment Gardens.—(E. Lawrence Mitchell. (147 pp.) London: P. S. King & Son, Ltd., 1922. 7s. 6d. net.) The growth of the demand for allotments in recent years has found legislative expression in several enactments, of which the most notable are (1) The Small Holdings and Allotments Act, 1908, (2) The Land Settlement (Facilities) Act, 1919, and (3) The Allotments Act, 1922, and any attempt to codify those Acts should be welcome to allotment societies, to members of local authorities engaged in their administration, as well as to urban landowners and others whose rights may be affected by their operation. Mr. Mitchell's administrative experience as Principal in charge of the Small Holdings and Allotments Branch of the Ministry has peculiarly fitted him to serve as a guide in this matter, and in this book he has set out concisely the powers and duties of local authorities in regard to the provision of allotments and allotment gardens, the statutory provisions governing their tenure, and the rights of tenants to compensation on dispossession. A useful feature of the book is the printing in full of the Act of 1908, indicating the amendments made by subsequent Acts, the relative portions of which are also set out, together with the Act of 1922 and copies of Regulations and Model Rules made by the Ministry.

A Vegetable Grower's Handbook.—(Miss Fanny Bennett, F.R.H.S., and Eleanor Sinclair Rohde. (174 pp.) London: Philip Lee Warner, 1922. 6s.) "To grow good vegetables dig, dig and still dig" is the emphatic advice of the two enthusiastic gardeners who in simple language seek in this little manual to impart the fruits of their experience to others who are fortunate enough to be their own gardeners. The key-note of the style is struck in the first sentence of the book: "If seed is to germinate it must be cosy and comfortable"; and the authors' insistence on the response of the plants to love and sympathy, combined with such practical "odds and ends" economics as the use of old shaving-brushes for washing off green fly, should appeal to suburban and other amateurs who might be repelled by the more pretentious technical and scientific works on the subject.

Fruit Packing for Market.—(W. P. Seabrook. (89 pp.) London: George Allen & Unwin, Ltd., 1922. 2s. 6d. net.) The increased atttention now being directed to problems of marketing gives a topical interest to this treatise, which is the outcome of an invitation by the Court of the Fruiterers' Company to the Chamber of Horticulture to make suggestions for furthering the Court's desire to publish a useful yet inexpensive book calculated to assist British fruit growers in meeting the competition from Overseas. A chapter is devoted to the British Growers' Scheme for grading and packing, which was described in the *Journal* of August, 1921. Sound practical directions are given which if followed would help to raise the standard of marketing to the level which is already generally recognized as essential to successful commercial cultivation.

Efficient Marketing for Agriculture.—(Theodore Macklin, Ph.D. (418 pp.) New York and London: Macmillan & Co., 1922. 12s. 6d.) A widely distributed trisectional cartoon in the *Country Gentleman*, reproduced in this book, representing on the left-hand side the farmer selling for one dollar a basket of potatoes which is being retailed to the consumer for three dollars at the other end, asks the pertinent question "What happens in the Dark?" (represented by the black space in the middle). To answer this question is the object of the illuminating text-book by the Professor of Agricultural Economics in the University of Wisconsin, who in this volume discusses dispassionately, from the point of view of the common interests of farmers, consumers and middlemen, the economic basis of marketing and the organization of such essential services as assembling, grading and standardizing, packing, "processing" (conversion of raw materials to finished products, as wheat into flour, milk into butter, &c.), transporting, storing, financing and distributing. The various marketing agencies and methods (including co-operative and "direct" marketing) are fully discussed; weaknesses in the present system are pointed out and suggestions made for improvement through the consolidation of uneconomic and inefficient middlemen wherever needless duplication exists, the establishment of working relations between farmers, middlemen and consumers and the organization of distributing agencies on the commodity basis. In the final chapter the functions of Government Authority in relation to marketing are classified as (1) maintenance of equality of opportunity; (2) securing by investigation or experimentation full facts about marketing; 3) establishment of minimum standards of competition; (4) enforcement of established standards of competition; and (5) education of the public to a comprehension of the economics of marketing.

A useful summary and bibliography is added at the end of each chapter and a very full index is appended.

Organised Produce Markets.—(J. G. Smith, M.A. (238 pp.) London: Longmans, Green & Co., 1922. 12s. 6d. net.) Though intended primarily for the use of students, this book, which is based on lectures delivered in the Faculty of Commerce of the University of Birmingham, should prove of interest and value to all who are concerned in the business of marketing—a subject which is now engaging particular attention as a branch of agricultural economics. The book gives a detailed description of the structure and working of the principal organised produce markets and exchanges in this country and in Europe and the United States, and the author's frank discussion of such abstruse and controversial subjects as the use and abuse of futures, and the influence of speculation on prices, is none the less stimulating because some of his conclusions—notably his defence of the "middleman" and the speculator in the economic scheme—would seem to challenge the doctrine of the co-operative direct marketing movement which regards the activities of these functionaries as mainly parasitic.

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Agriculture, General and Miscellaneous.

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After-ripening, Dormancy, and Methods of Terminating the Dormant Period of Seeds, *Cyril West.* (Sci. Prog., No. 67, Jan., 1923.) [58.11; 63.1951.]

The Flocculation of Soils. III, *N. M. Comber.* (Jour. Agr. Sci., xii (1922), pp. 372-386.) [63.111.]

Weather Cycles in Relation to Agriculture and Industrial Fluctuations. (Nature, Dec. 30, 1922, p. 889.) [551.5.]

Farm Costings in Ireland, *J. M. Adams.* (Jour. Dept. Agr., Ireland, Nov., 1922.) [657.]

Agricultural Shows, their Present Functions and how they can be Usefully Extended, *W. P. Crosland.* (Jour. Farmers' Club, 1922, Part 6) [63(064).]

Field Crops.

Green Peas as a Money-Making Farm Crop: How they paid £27 4s. 5d. per acre profit in 1922, *A. G. Ruston* and *J. S. Simpson.* (Mod. Farming, Nov., 1922.) [63.32.]

Studies on the Effect of Nitrogen Applied to Oats at Different Periods of Growth, *W. F. Gericke.* (Jour. Amer. Soc. Agron., Nov, 1922.) [63.314.]

Breeding Oats Resistant to Stem Rust, *F. Griffee.* (Jour. Hered., xiii (1922), pp. 187-190. [575.4.]

Ensilage, *E. F. Campbell.* (Scot. Jour. Agric., Oct., 1922.) [63.19832.]

Temperature and Other Factors Affecting the Quality of Silage, *A. Amos* and *G. Williams.* (Jour. Agr. Sci., xii (1922), pp. 323-336.) [63.19832.]

An Investigation into the Changes which occur during the Ensilage of Oats and Tares, *A. Amos* and *H. E. Woodman.* (Jour. Agr. Sci., xii (1922), pp. 337-362.) [63.19832.]

Fruitgrowing.

Winter Pruning Experiments with Apple Trees, *N. H. Grubb.* (Jour. Roy. Hort. Soc., Vol. 47, Parts 2 and 3, Sept., 1922.) [63.41-195.]

Plant Pests and Diseases.

A Study of the Life-History of the Onion Fly (*Hylemyia antiqua*, Meigen), *K. B. Smith.* (Ann. App. Biol., Vol. ix (1922), Nos. 3 and 4, pp. 177-183, plates x and xi.) [63.27.]

Studies on the Apple Canker Fungus. I—Leaf Scar Infection; II—Canker Infection of Apple Trees through Scab Wounds, *S. P. Wiltshire.* (Ann. App. Biol., Vol. 8 (1921), pp. 182-192; Vol. 9 (1922), pp. 275-281.) [63.24-41.]

Further Studies on the "Brown Rot" Fungi. 1. A Shoot-Wilt and Canker of Plum Trees caused by *Sclerotinia cinerea* (with plates), *H. Wormald.* (Ann. Bot., Vol. 36, No. 143, July, 1922.) [63.24.]

Leaf Roll and Mosaic Diseases of the Potato, *P. A. Murphy.* (Jour. Dept. Agr., Ireland, Nov. 1922.) [63.23.]

A Bacterial Disease of Turnip (*Brassica napus*), *S. G. Jones* (Jour. Agr. Sci., Vol. xii, Part 3, July, 1922.) [63.23.]

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The Sugars and Albuminoids of Oat Straw, *S. H. Collins* and *B. Thomas.* (Jour. Agr. Sci., Vol. xii, Part 3, July, 1922.) [63.60432.]

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Milk Yields, Cost per Gallon and Financial Results, *James Wyllie* (Scot. Jour. Agr., Oct., 1922.) [63.714; 63.711 (*b*).]

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The Scandinavian Food Unit, *D. W. Steuart.* (Scot. Jour. Agr., Oct., 1922.) [63.711(*a*); 63.711(*b*).]

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The Warble Flies: Sixth Report on Experiments and Observations as to Life History and Treatment, *Carpenter, Phibbs & Slattery.* (Jour. Dept. Agr., Ireland, Vol. 22, No. 1, May, 1922.) [619.2(*f*).]

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The Relative Advantages and Cost of Working the Land by (*a*) Horse Labour, (*b*) Steam, or (*c*) Tractor, *James Falconer.* (Jour. Farmers' Club, 1922, Part 5.) [388.58; 63.196.]

Local and Imperial Taxation as Affecting Agriculture, *Sir R. H Rew.* (Jour Farmers' Club, 1922, Part 4.) [336.2; 336.28.]

**Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE,
By Metchim & Son, Princes Street, Westminster, S.W. 1.**

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXIX. No. 12.

MARCH, 1923.

NOTES FOR THE MONTH.

Committee on Agricultural Prices and Distribution.

In reply to a question in the House of Commons by Lieut.-Col. Arthur Murray as to when the Report of the Agricultural Prices Committee would be published, the Minister of Agriculture, Sir Robert Sanders, replied:—"I am advised that with the exception of one or two witnesses who may be reheard on specific points, the Committee has concluded the hearing of evidence with regard to milk and dairy produce, and as soon as the mass of essential statistical data has been assembled, co-ordinated and considered, an interim report in respect of this commodity will be issued. I hope, in due course, to receive interim reports as regards fruit, vegetables and meat, in respect of which, I gather, provisional evidence has already been heard, and, subsequently, as regards cereals and bread. The hon. and gallant Member will realise that the Committee is confronted with a task of exceptional complexity and magnitude, and one which in the nature of things cannot be hastened without seriously prejudicing the Committee's investigations.

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Co-operation in Agriculture, 1921.

The Ministry of Labour Gazette for February, 1923, contains a summary of the statistics relating to agricultural co-operation in 1921 collected under the Industrial and Provident Societies Acts. This is the first article on the subject published by the Ministry of Labour since 1915.

In 1921 there were 1,201 registered co-operative societies engaged in agricultural production and distribution in Great Britain. Of these 829 were engaged mainly in the distribution of seeds, implements, manures, etc.; 200 in the preparation and disposal of agricultural products, chiefly butter and other dairy

produce; and 172 were farming and dairying departments of non-agricultural co-operative societies.

The 1,029 agricultural societies had an aggregate membership of 162,374, a decrease of 3,010, or 1.8 per cent., on that of the preceding year. The total share, loan, and reserve capital amounted to £3,820,000, an increase of £323,000, or 9.2 per cent., on the amount in 1920. The total sales realised £16,632,000, a decrease of nearly £5,000,000 (22.5 per cent.), and the year's trading resulted in a loss of £153,000, which was, however, less than that (£210,000) incurred in the preceding year.

In 1915 the special feature of these returns was the great predominance of the Irish societies in agricultural production, nearly 81 per cent. of the sales by productive societies and departments in the United Kingdom being in that country. In agricultural distribution the societies in England and Wales predominated with over 62 per cent. of the total sales. By 1920 a considerable increase in co-operative sales had taken place in both countries, but the share of Great Britain had increased more than that of Ireland, the sales by British productive societies being 46 per cent. of the whole, and by British distributive societies 80 per cent. For the year 1921 Irish figures are not available.

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Nauru Phosphate.

UNDER the terms of the Nauru Island Agreement Act, 1920, the phosphates produced in any one year in Nauru and Ocean Islands are allocated in the following proportions:—to the United Kingdom 42 per cent., Australia 42 per cent. and New Zealand 16 per cent. These allotments are intended primarily for home consumption for agricultural purposes in the country of allotment, and not for export.

At the expiration of the period of five years from the coming into force of the Agreement, *i.e.*, in 1925, and every five years thereafter, the basis of allotment is to be readjusted in accordance with the actual requirements of each country. If in any year any of the three Governments does not require any portion of its allotment, the other Governments are entitled, so far as their requirements for home consumption extend, to have that portion allotted among themselves in the proportions of the percentage to which they are entitled as given above. Any phosphates not required by the three Governments may be sold

by the Commissioners, who have been appointed under the Agreement, at the best price obtainable.

The total quantity of phosphates shipped from Nauru and Ocean Islands during the two and a half years ended 31st December, 1922, was 886,830 tons, which was made up as follows:—

To the United Kingdom	32,300 tons
,, Australia	541,420 ,,
,, New Zealand	80,900 ,,
,, Other countries	232,210 ,,

It will be seen, therefore, that during the period mentioned, the United Kingdom has taken considerably less than its quota. The reasons for this may be briefly summarised as follows:—

1. Owing to the present depressed state of agriculture in this country and the serious shortage of capital among farmers, the purchase of fertilisers, even of kinds well-known to the home farmer, has been considerably below normal

2. The makers of superphosphate had long-dated contracts for supplies of North African and American phosphates much in excess of their actual need under existing conditions.

3. Owing to the fact that Nauru phosphate could not be sold to the superphosphate makers, it was put on the market in a finely ground state, in which form it was to be expected to be effective as a slow acting phosphate fertiliser, giving results similar to those obtained from basic slag. British farmers are, however, without experience of the results to be obtained from this or other ground raw phosphates. A considerable number of experiments have been started to test the value of Nauru phosphates, but time is necessary before these become available, and the dry season of 1921 caused a further delay in reaching satisfactory conclusions. The lack of this direct evidence of the value of Nauru phosphate has added to the disinclination of farmers to purchase the new fertiliser on any considerable scale.

4. Owing to the high freight charges which prevailed throughout the period during which practically the whole of the Nauru phosphate that has so far reached this country was shipped, the distributors have been unable to place the material on the market at so attractive a price as will be possible with shipments made under the present considerably reduced freight charges.

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British Bee Keeping.

THE steady increase in the colonies of bees in this country coincides with a marked decline in the importation of honey, for while the imports in 1919 amounted to 173,228 cwt., they dropped in 1920 to 53,021 cwt., and again in 1921 to 24,984 cwt. The British bee keeper has probably recovered much of the ground lost through the ravages from 1907 to 1912 of Acarine disease, and through the subsequent dislocation of working conditions during the years of war. Satisfactory as these figures are, however, they show that the home producer has still some leeway to make up to meet the present demand, and to educate the public concerning the value of honey in the dietary.

Further progress will probably depend on augmenting the number of bee keepers; and with this object in view the Ministry has prepared a sectional volume of leaflets, dealing with the various aspects of bee keeping, which can be obtained at a cost of 6d. by applying to the Secretary of the Ministry at Whitehall Place, London, S.W.1. Although, by reason of climatic conditions, bee keeping on a large scale in this country has been and only can be successful to a limited extent, it is not fully realised what an eminently suitable activity it is for the smallholder and cottager or for the town-worker living in the country, to all of whom it offers a profitable "side-line" occupation at a comparatively small outlay in money and time. No more space is required than the few square feet on which the hives stand, and the attention demanded by the care of a few stocks of bees is certainly less than is often expended on far less remunerative occupations. Apart from the value of the work done by bees in gathering nectar that would otherwise be wasted, it should be remembered that they are active pollinators of fruit blossoms, and therefore of inestimable benefit to the fruit grower and the gardener.

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The Agricultural Index Number.

THE average prices of several classes of agricultural produce in England and Wales were higher during January than in December, 1922, the most noticeable increases being in fat cattle, fat sheep and cheese. On the whole prices were 68 per cent. above those ruling in the corresponding month in the years 1911-13, against 59 per cent. above in December. The increase in January, 1922, was 75 per cent., so that as com-

pared with a year ago prices have only receded by 4 per cent. (7 points) on the whole. The percentage increases in each month since January, 1920, are shown in the following table :—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.
January	200	183	75	68
February	195	167	79	—
March	189	150	77	—
April	202	149	70	—
May	180	119	71	—
June	175	112	68	—
July	186	112	72	—
August	193	131	67	—
September	202	116	57	—
October	194	86	59	—
November	193	79	62	—
December	184	76	59	—

Wheat was a little firmer than in December, whilst the rise in oats was appreciable, this cereal selling at 43 per cent. more than in January, 1911-13. Barley declined slightly, but as the fall in January is usually proportionately greater, the index figure is higher than last month. All three cereals are cheaper than a year ago, especially barley, which only averages 20 per cent. above the pre-war price. Meadow hay fell slightly, and potatoes sold at practically the same prices as in January, 1911-13.

All kinds of live stock were relatively dearer than in December, and sheep and pigs made much higher prices than in January, 1922. Fat cattle, at 61 per cent. above 1911-13, were practically the same as a year ago, and dearer than in any month since August last. Fat sheep and fat pigs were each rather more than double the pre-war price, the index number rising appreciably in each case as compared with December. Prices of fat pigs, however, were practically unchanged on the month, the rise in the index number being due to lower prices ruling in January than in December, 1911-13. Store cattle, sheep and pigs all rose in price, but while store cattle at 36 per cent. above 1911-13 were rather cheaper than a year ago, store sheep and pigs made much more money than in January, 1922. The index number of store sheep is practically the same as that of fat sheep, but store pigs at 171 per cent. above the pre-war price are relatively much dearer than fat pigs. The very high prices of store pigs are no doubt mainly due to the demand for pigs to consume the surplus supplies of potatoes.

Milk and butter remained stationary, but cheese rose sharply and, at 85 per cent. above 1911-13, was relatively dearer than butter. Both butter and cheese sold at much higher prices than in January, 1922. The fall of egg prices was not so sharp as usual so that the index number is 23 points higher than in December.

The following table shows the average increases during recent months in the prices of the principal commodities :—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

	1922				1923.	1922.
Commodity.	Sept.	Oct.	Nov.	Dec.	Jan.	Jan.
Wheat ...	23	24	32	32	33	44
Barley ...	26	29	34	17	20	51
Oats	31	33	38	36	43	49
Fat cattle ...	58	49	48	48	61	62
Fat sheep ...	90	90	87	81	103	60
Fat pigs ...	84	85	94	94	102	71
Dairy cows ...	63	69	74	72	74	87
Store cattle ...	33	30	29	28	36	41
Store sheep ...	109	106	93	83	105	51
Store pigs ...	125	135	148	151	171	91
Eggs... ...	96	104	98	63	86	114
Poultry ...	85	77	75	86	81	76
Milk	70	90	90	90	90	125
Butter ...	76	71	72	73	73	46
Cheese ...	41	36	55	60	85	27
Potatoes ...	1	3	8	7	—1*	113
Hay	52	45	45	47	43	35

* Decrease.

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Conciliation Committees in Agriculture.

THE agreement of the Lancashire Committee for the Northern Area of the county which was due to expire on 31st January, 1923, has now been extended to 30th April. The agreement provides for the payment of a rate of 37s. 6d. to teamsmen and stockmen for a week of the usual working hours, with proportionate rates for other workers.

Average Wages.—There was little change in the weekly wages of ordinary agricultural labourers in England and Wales during January.

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THE NEW DEVELOPMENT FUND FOR AGRICULTURE.

UNDER the Corn Production Acts (Repeal) Act, 1921, a sum of £1,000,000 was provided for agricultural research and education, the allocation to England and Wales being £850,000 and that to Scotland £150,000. After the passing of the Act decisions had to be reached in the case of England and Wales as to the period in which the fund was to be expended. It has now been agreed that in general the fund (with the interest upon it) may be expended in the five-year period April, 1922, to March, 1927, and the allocation at present contemplated is approximately as follows:—Research and Advisory work, £465,000; Higher Agricultural Education, £84,000; County Agricultural Education, £170,000; Scholarships for the sons and daughters of agricultural workers, £117,000; Miscellaneous Schemes, £74,000. This allocation is provisional, and if on investigation the schemes in contemplation prove more or less expensive than anticipated some re-arrangement may prove necessary. Particulars of grants to be defrayed wholly or principally from the new fund, in so far as definite decisions have already been made, are given below.

National Institute for Research in Dairying.—A grant of £10,900 has been approved from the Fund in aid of the erection and adaptation of buildings, the provision of engineering plant, etc., on the Shinfield Manor Estate (near Reading) for the purposes of a dairy farm for the Institute. The total cost of the building scheme is £26,000; of this sum £13,000 is being provided by the Institute and £13,000 from Government funds.

Silver Leaf Disease Research at Cambridge University.—Research into Silver Leaf Disease of fruit trees has been carried on in a very small way for several years. The Fund has made it possible to extend this work, and a larger scheme continuing until 1927 has been approved in principle. A grant of £950 for capital expenditure (accommodation for pot plants) has been approved, together with a grant of £800 for maintenance purposes in the six months ending March, 1923. It is expected that it will prove possible to approve grants at the rate of £1,550 per annum after March.

East Malling Research Station.—A grant of £6,600 has been sanctioned towards a capital expenditure by the Station amounting to £9,400, as follows:—Working Capital, £4,000; Oast

House, £1,400; Houses for Director and Caretaker, £2,000; Propagation House and Orchard House, £2,000.

Agricultural and Horticultural Research Station, Long Ashton, Bristol.—A grant of £5,000 has now been approved from the Fund towards a capital expenditure of £6,750 by the Station on the development of land, purchased in 1920, as a fruit plantation, on making a road, and providing buildings and laboratory accommodation.

Testing of Varieties of Fruit.—A scheme extending over ten years has been drawn up in co-operation with the Royal Horticultural Society for the testing of the potential value of varieties of fruit for market purposes; the scheme is under the control of a Joint Committee of the Ministry and the Society. The tests are to be carried out, in the first place, at the gardens of the Royal Horticultural Society at Wisley, but sub-stations will be set up as the scheme progresses. Approval in principle has been given to the scheme which is estimated to cost £12,000 in ten years, and a grant of £345 has been sanctioned from the Fund for the six months' period ending March next.

Experimental and Research Station, Cheshunt.—A grant of £1,125 has been approved in aid of capital expenditure by the Station amounting to £2,250 on new glass-houses, required for breeding and physiological investigations on glass-house crops.

Fruit Soils Survey.—This investigation, in which the Universities of Bristol and Cambridge are co-operating, is being directed to ascertain the extent to which fruit culture can be correlated with soil types in the two districts of East Anglia and West Midlands. Approval of the work in principle for the two years has been signified and grants totalling £700 for the year October, 1922, to September, 1923, have been promised.

Research Scholarships and Travelling Fellowships.—An expenditure of £2,000 a year has hitherto been incurred in providing these scholarships and fellowships. To this sum a further £2,000 is proposed to be added per annum until March, 1927, to enable the number of scholarships and fellowships to be increased.

Research in Animal Diseases.—A scheme for the establishment of an Animal Pathology Research Institute at Cambridge University is under consideration, and the extension of work already in progress at other centres is proposed. A grant of

£30,000 to provide for the endowment of a professorship in Animal Pathology at Cambridge has been accepted by the University Authorities, who will proceed shortly to the election of the professor.

The Provision of Technical Advice and the Investigation of Local Problems.—There are three main developments of this work which are being financed from the Fund. In the first place the Ministry's scheme of advisers in plant pathology will be completed so that there will be an advisory entomologist and an advisory mycologist at each of thirteen provincial centres in England and Wales. These centres have been increased from eleven by the establishment of advisory centres at Cardiff University College and at Seale Hayne College. In addition to the completion of the Plant Pathology Advisory scheme, it is hoped to provide veterinary advisers at selected centres (one such adviser has already been appointed at Cardiff). The cost of the Advisory Service before the Fund was established was £21,000 per annum, and an additional grant to the Ministry of £2,600 for the purpose for the academic year October, 1922, to September, 1923, has been sanctioned. In the third place the provision of funds for extension of advisory work in agricultural costings at various centres (Cambridge, Reading, Wye and Leeds) has been approved; the cost will be approximately £3,000 to £3,500 per annum.

Education at University Departments of Agriculture and Agricultural Colleges.—£64,000 has been provisionally allocated for grants in aid of capital expenditure at University Departments of Agriculture and Agricultural Colleges. The following projects have been, or will be, aided out of this money. A grant of £15,000 enabled the Royal Agricultural College, Cirencester, to re-open at the beginning of the present session after having been closed since 1914, owing to the War. The scheme for providing new buildings for the Agricultural Department of the University of Leeds, which had to be stopped in 1914, will shortly be put in hand (grant £15,000). The University of Cambridge has been promised £10,000 to enable the School of Agriculture to acquire the freehold of the two farms, now held on a precarious leasehold tenure and used for teaching and research purposes. A grant of £1,500 to the Governors of the Horticultural College for Women at Swanley has enabled improvements to be effected in the laboratory, the dairy and the library, and a loan of £3,500 on mortgage at 5 per cent. will relieve the financial embarrassments which have for some time been a source of anxiety to the Authorities of the College.

Proposals are under consideration for aiding the provision of new buildings for the Agricultural Department of the University College of North Wales, Bangor, and for improving the accommodation at the British Dairy Institute, Reading.

County Agricultural Education.—£70,000, spread over 4 years, has been allocated for increasing the annual grants to counties, and so make possible the extension of their systems for providing instruction and advice in agricultural subjects. A capital grant has been sanctioned to enable the Pibwrlwyd Farm Institute Scheme (Carmarthenshire) to be proceeded with, and the question of reviving the other Farm Institute Schemes (in Durham, Kent, Lincolnshire (Holland) and West Sussex), which were stopped by the Cabinet veto in 1920, is under consideration.

The National Poultry Institute Scheme.—Proposals involving a net charge on the Fund of some £43,500 for development of the poultry industry, have reached an advanced stage of consideration, and more than £5,000 has already been raised by the industry towards the estimated capital expenditure of £26,000. The scheme contemplates that the industry should find one-fourth of such capital expenditure. It includes provision of facilities for higher instruction in poultry-keeping and commercial experiments at Harper Adams College, for research into problems of nutrition and breeding at Cambridge, for research into poultry diseases at the Ministry's Laboratory at Addlestone, and for breeding experiments connected with egg production and table-poultry production.

Scholarships for the Sons and Daughters of Agricultural Workers.—Section 3 of the Corn Production Acts (Repeal) Act, 1921, which established the Fund, mentioned this purpose specifically as one of those to which the money was to be applied. A scheme is now in operation under which the following scholarships may be awarded annually :—

10 Class I, enabling the holder to take the degree course in agriculture at certain University Departments.

10 Class II, enabling the holder to take a 2 years' course in agriculture at certain University Departments and Agricultural Colleges.

300 Term Units—Class III, enabling the holder to attend courses of not more than one year's duration in agriculture, horticulture, dairying or poultry keeping at Farm Institutes and similar Institutions.

A Central Committee, which includes representatives of University Institutions, Agricultural Colleges, County Authori-

ties for Agricultural Education Representatives, Organised Associations of Agricultural Workers, the Board of Education and the Ministry, has been set up to make the selections for Class I and Class II awards, and to advise the Ministry generally on the scheme. There are at present, 3 students holding Class I Scholarships at Cambridge and 4 at other University Departments; 10 hold Class II awards at Agricultural Colleges and 73 hold Class III awards at Farm Institutes. The total cost of the scheme is estimated at £117,000.

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A SUCCESSFUL METHOD OF DEALING WITH SURPLUS MILK.

J. G. ASTON and C. T. SPROSTON.

IN common with other milk-sellers the members of the Frodsham Branch of the National Farmers' Union were annually faced with the recurring problem of how to deal with surplus milk. They realized the futility of advising their members that they must only sell their milk at a reasonably profitable price. without providing an alternative method for dealing with the milk of members who were unable to realize those prices, for in order to avoid immediate loss this small minority will sell their milk for the best price they can get at the time and thus weaken the position of the whole of the milk producers in the district.

In the early part of the year 1920 the late Mr. Robert Shepherd, of Parkside, Aston, was asked to draw up a scheme to deal with this difficulty, and a considered scheme was laid before a meeting of a large body of farmers in February of that year. The scheme was adopted and a committee was formed with Mr. C. T. Sproston as chairman. The energy with which the committee set to work may be gauged by the fact that within 4½ months of the scheme being accepted a society was formed and called the Frodsham Area Surplus Milk Society Ltd. The necessary capital—some £5,000—had been secured or promised, land had been acquired, and a splendid up-to-date factory had been built and equipped and was working.

At the opening of the factory, the Chairman, Mr. C. T. Sproston, said the object of the scheme was to manufacture surplus milk into cheese, and thereby help farmers to obtain a reasonable and fair price for their milk. Up to then during the flush season the surplus milk of the area had been dumped on

to the wholesale buyer in such quantities that he had been unable to deal with it, causing a considerable loss of the finest food that the country produces. By converting this surplus milk into good cheese the whole community would benefit.

It is easy to see that the working of this scheme ensured a level supply of milk to the wholesale buyer, and consequently the farmer can get 1d. or 2d. more per gallon for the quantity he sells. This means a considerable sum in the course of a year; for example, 2d. per gallon per day on a fifty-gallon per day dairy means 8s. 4d. per day, or £152 a year. Hence, even if a shareholder is not getting any direct profit on his capital invested in the scheme he benefits considerably indirectly.

Capital.—It was considered that it would be necessary to raise £5,000 to establish the scheme on a satisfactory basis and provide for all reasonable requirements. The money was to be subscribed by farmers, milk producers or others directly or indirectly connected with farming, on the basis of one £1 share per dairy cow, with a minimum holding of 5 and a maximum of 200 shares for each member, excepting where a reasonable case of an embarrassed financial position is established by a milk producing member. The share capital is in £1 shares bearing interest at the rate of 5 per cent. per annum. Each shareholder contributes an annual levy of 1s. per share. The interest and the levy thus balance each other, so that in practice the shareholders receive no interest on the capital, but only the returns from the operations of the factory.

System of Management.—The staff consists of one dairy maid only, with extra help when required, and the factory is managed by two Honorary Managers and a small Committee and Secretary. The system of management is not to buy or sell any milk whatsoever, but only to manufacture surplus milk into cheese and pay on results, less cost of manufacture. The financial position of the society is therefore always safe. Naturally some will be curious to know what use is found for the factory when there is no surplus milk. This difficulty was foreseen in building the premises, and the cheese room—known in the district as the Agricultural Hall—was made extra large, fitted with a wood block floor and ladies' and gentlemen's dressing rooms, and is readily let for public meetings, dances, whist drives, etc., when not required for the storage of cheese, and brings in a very handsome revenue which is applied towards the payment of establishment expenses. In consequence of these uses the dairymaid is well occupied in keeping the premises clean.

Building and Equipment.—The building consists of a large dairy, boiler house, extra large cheese room with ante-rooms adjoining, a milk-receiving platform, where milk is unloaded and weighed before running into the vats, and a large whey tank. The equipment is capable of dealing with 7,000 gallons of milk daily. The vats are heated by steam from a large boiler. The milk is conveyed in troughs from the weighing machine to the vats, and the whey flows down a channel to the whey tank, and is readily sold to farmers in the district for pig feeding. The curd mill is controlled by electric power and the whole building is lighted by electricity. Town water is laid on and the drainage is connected to the town sewers.

The Society was registered under the Industrial and Provident Societies Acts, 1893, and rules were formulated by the Committee of Management for the control of the Society and submitted to the Government Registrar and embodied in the Government Model Rules. The Committee of Management hold monthly meetings for the purpose of transacting the business of the Society, when statements are laid before them showing the exact financial position to the date of meeting, and the number of gallons of surplus milk received and manufactured into cheese, and the cheese sold and in stock. The shareholders have an annual meeting in January and a half-yearly meeting in July, at which audited statements of accounts are produced and circulated to all shareholders.

Results.—The result of the first year's working, ending 31st December, 1921, taking into account the bad state of trade generally, and the price paid to those who sent surplus milk, was considered to be most satisfactory. The total quantity of surplus milk dealt with for that period was 90,000 gallons. For the year ended 31st December, 1922, the quantity was 12,952 gallons. Although the quantity of surplus milk dealt with during the year 1922 was much smaller than 1921, this is accounted for by the greater demand by the public for milk. The factory, however, can claim to have served the purpose for which it was originally built, and it has been a boon to many farmers when their supplies were stopped to have such a place to which they could send their milk. The Committee have been able to pay very substantial prices per gallon for the milk sent in during the past year, and the Society is in a sound financial position. The cheese made is sold only when there is a demand for it on the market.

If this article should be a means of inducing farmers in other parts of the country to consider establishing surplus milk

factories on the same lines, it would be wise for them to keep in mind the advantage of erecting the factory near a populous neighbourhood so that the premises may be let during slack periods as described above.

The Committee of Management are of the opinion that if similar factories were erected throughout the country the problem of dealing with surplus milk would be more easily overcome, and the fixing of prices at contract time would be more equitably arranged between producer and buyer. The Committee is prepared to give farmers all the assistance possible by placing their rules, etc., before them, and by receiving deputations for a personal inspection of the factory.

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SHEEP SCAB: SUCCESSFUL METHODS OF ERADICTION ON THE PRECELLY RANGE, PEMBROKESHIRE.

G. V. SLINN, M.R.C.V.S.,
Ministry of Agriculture and Fisheries.

THE Precelly Range lies in the north of Pembrokeshire and is in extent between 6 and 8 miles long and about 3 miles in breadth. The highest peak, Foel Cwm Çerwyn, is 1,760 feet above sea level. The lower portion of the range is marshy, but generally the pasturage is good and the ascent of the range is not steep. There are practically no farms or holdings on the mountain, all of them being situated along the foot. The sheep running on the range are the usual type of small cross-bred Welsh. They are allowed to run on the mountain throughout the year and the majority lamb there, only the weaker ones being brought down for this purpose. It is usual to allow one ram to about twenty ewes; lambing commences towards the end of February and terminates usually by the middle of May. The sheep are gathered for washing about the middle of June and this is done collectively. They are then turned back to the range and are brought down later in smaller lots for shearing.

The sheep on the range all belong to the farmers who have their farms at the foot of the range and have the right of grazing. No other sheep are brought on to the range for this purpose. The number of sheep on the mountain varies according to the year but the average is about 13,000.

Public Dipping Baths.—In 1910 sheep scab was very prevalent on this range and from October of that year to September, 1911, 52 cases were found. In 1911 the Board of Agriculture made an order for the double dipping of all sheep on the Precelly Mountain Range and on the farms in contact with the range. In order to carry out this double dipping effectively the County Council sanctioned the erection of six public dipping baths on the range, and during that year six centres were selected by the Chief Constable of the County in conjunction with an Inspector of the Board of Agriculture. The centres selected were at Clynseithmaen, Caermenin, Penygroes, Brynberian, New Inn, and Ffynondicki.

The baths and the receiving and dripping pens were erected at the expense of the County of Pembroke. The farmers, however, undertook to do all the haulage of the material for the work. The size of the pens varies slightly at the various baths, but the average is 36 ft. by 30 ft. At one bath, Brynberian, where a large number of sheep are dipped, there are two dipping tanks side by side with pens 52 ft. by 30 ft. The dipping tanks are made of concrete and the fencing of the pens is of half width old railway sleepers and originally, square mesh sheep netting, somewhat similar to that in use in Canada, was used. This, however, was found to be too large a mesh and an ordinary small mesh wire netting was substituted and proved effective. The cost of the six stations was £126.

At first the floors of the pens were natural earth; this, however, was found to be very undesirable as the baths were fouled very quickly, necessitating continued and otherwise unnecessary cleaning of the tank and renewal of the dip. In 1918 the County decided to cement each of the receiving pens at a cost to the County of just under £320, which amount represents the cost of cement and labour connected with mixing and laying the concrete; the farmers provided the aggregate and as before did all the haulage. It must be borne in mind in connection with this expense that the baths are widely distributed and in out of the way places. with no facilities for lodging the workmen who had to be conveyed to and from work, and the high prices ruling during the year this work was done (1918) must also be taken into account.

The plan and illustration show the arrangement at Brynberian, where two tanks are provided. Water for the baths and for cleaning the receiving pen is conducted by gravitation from

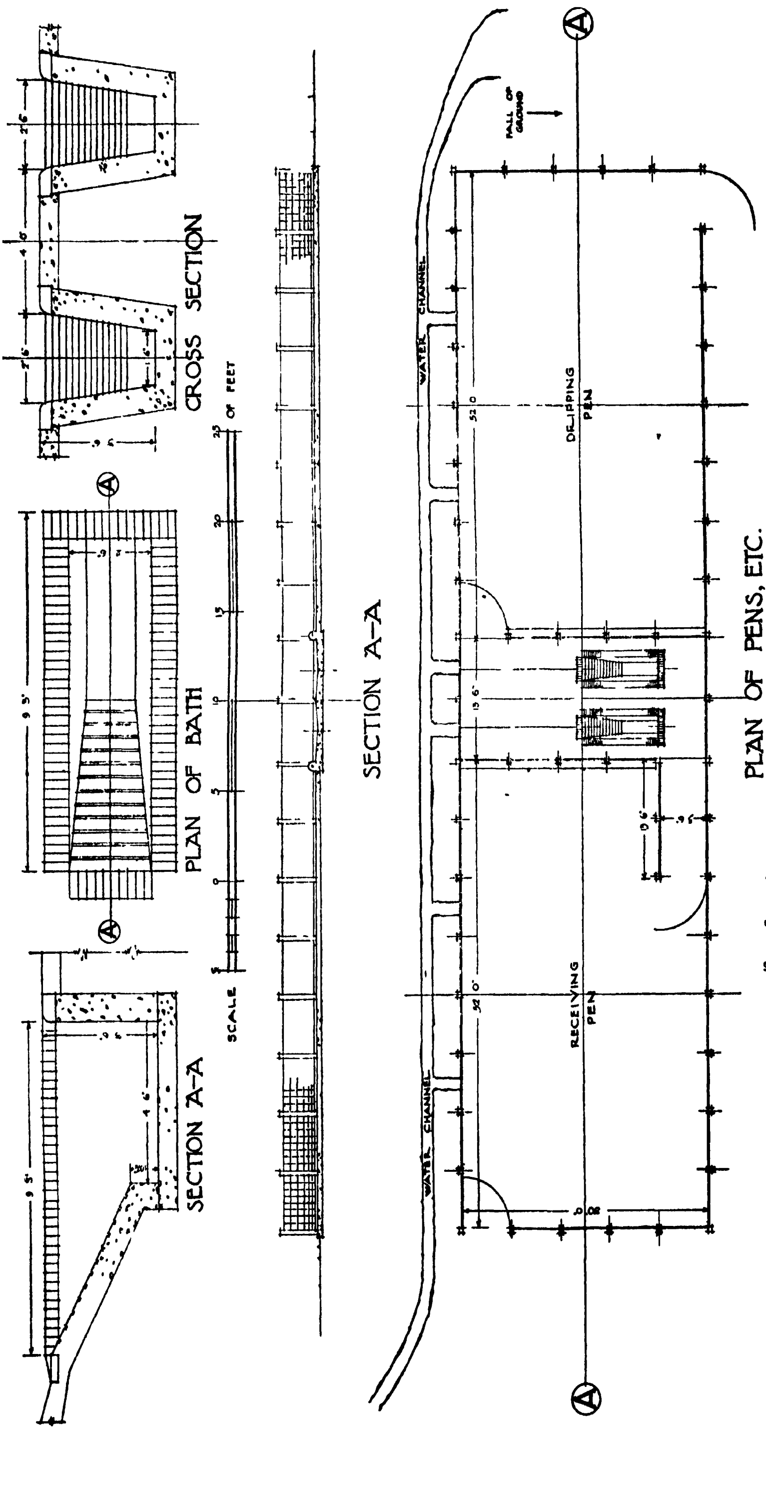

FIG. 1.—Pembrokeshire County Council. Plan of Sheep Dipping Baths and Pens,

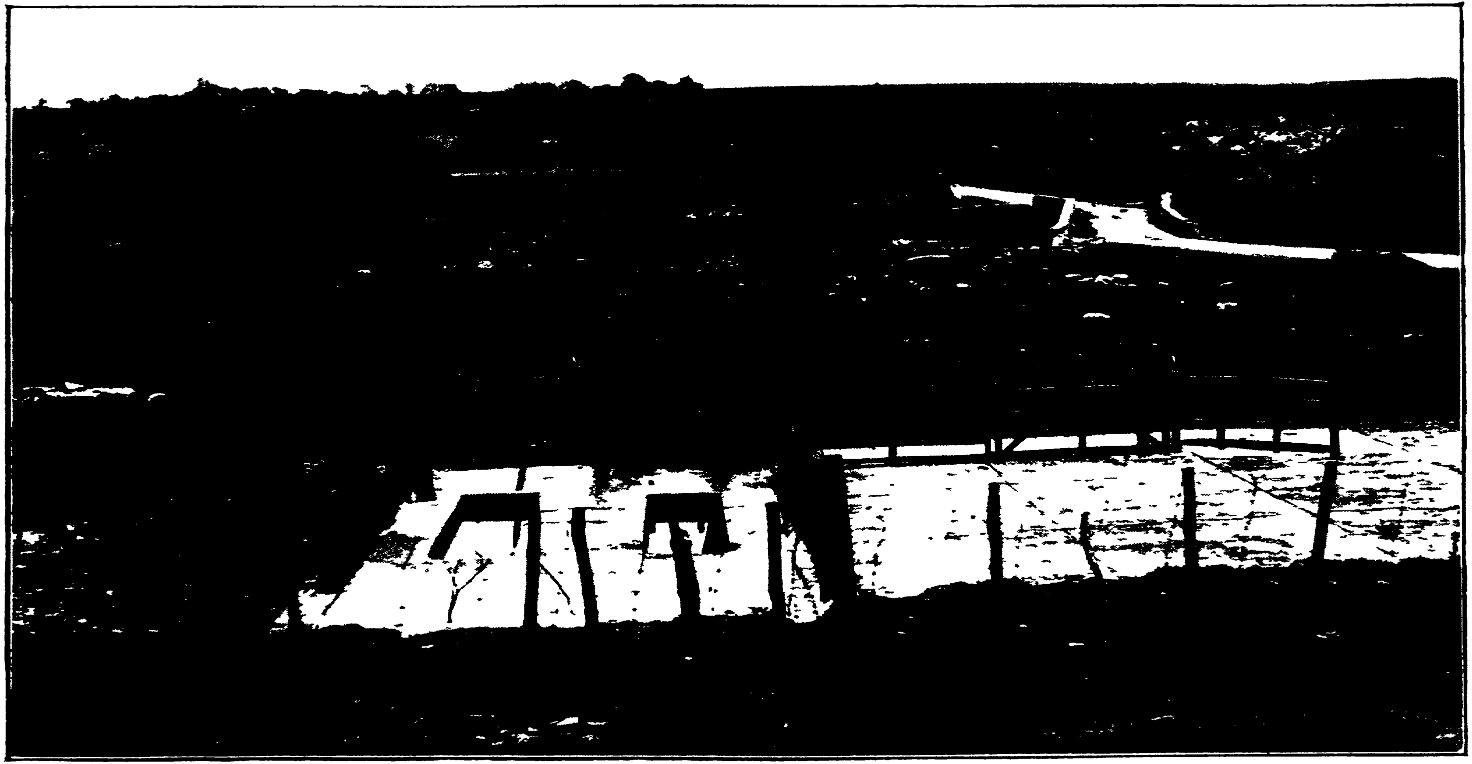

FIG. 2 —General View of Sheep Dipping Baths and Pens.

watercourses in the vicinity of the baths. no outlets are provided and the baths are emptied by bailing: it was thought that with a pipe outlet there was danger of this getting stopped up with sediment. The County last year sanctioned the cementing of the dripping pens and this work will be put in hand in due course, thus making what will be as near as possible ideal dipping baths and centres.

Progress of Eradication.—In 1911 the County supplied the sheep dip and all the sheep on the range were dipped free of charge. In the following year the County again supplied the dip but a charge of one penny per sheep was made for the double dipping, and this was collected by the Police Officers in charge at each bath. From 1913 to the present day the farmers have supplied their own dip, and they also keep the fencing of all the pens in good order. The County authorities continue to be responsible for the upkeep of the baths and undertake any necessary repairs. In winter the baths and floors of the pens are well covered with bracken and similar material as a safeguard against injury from frost.

The double dipping Order was kept in force until 1914, in which year the number of cases of sheep scab on the range was reduced to three. Since 1915, in the absence of scab, a single dipping only has been carried out, and it is very satisfactory to be able to record that from 1915 to the date of writing no case of sheep scab has been found on the mountain or traced to sheep running thereon. For this excellent result the action of the County Authorities in equipping the centres, the very thorough manner in which the dipping has been organised by the Chief Constable of the County and carried out by the Police Officers under him, and the ready co-operation of the flock owners, are responsible.

Method of Dipping.—The arrangements for carrying out the dipping are as follows:—

The date is fixed for the dipping by the Local Authority and the farmers are given due notice. On the day before the dipping two Police Officers are told off for duty at each centre, where they arrive at 10 in the morning and satisfy themselves that the baths and pens are in order and clean, and the fencing in good repair. They then accompany the farmers with their dogs up the mountain. When they all are at their respective stations along the top ridge of the range the Superintendent of Police in charge gives the signal, usually by waving two flags, to start driving the mountain, the signal

being given as nearly as possible at an agreed time. The whole of the mountain is thus simultaneously driven and all sheep brought down to the various centres in order to commence dipping as early as possible on the following morning. The control of the sheep during the night is by watchers and dogs, and works satisfactorily. On the day of dipping another party with dogs, and again accompanied by the police, start in the morning as soon as it is light from each centre and search the mountain to collect any stray sheep which may have escaped the first drive, and no sheep are allowed to return to the mountain until all the parties have returned with the collected strays, after which the sheep which have been dipped are permitted to go back to the mountain.

A police officer is in charge of each bath and he supervises the mixing of the dip in strict accordance with the manufacturer's directions and sees that the dip is one approved by the Ministry. He also sees that the dip is kept up to full strength and sees that every sheep is properly and effectively dipped. The length of time each sheep is in the bath is taken by the watch. The number placed in the bath at once varies from three to five in accordance with the size of the sheep. The officer in charge also keeps a record of the number of sheep dipped at his centre. At the single dipping in August of last year 12,849 sheep were dipped and no casualties occurred; in addition to these 1,676 sheep were brought to the baths from farms adjoining the range and in contact with them, making a total of 14,525.

From the above particulars it is, I think, clearly shown that sheep scab can be eradicated from a mountan range if the following essentials are carried out:—

(1) A simultaneous double dipping with an approved dip of all the sheep on the range, the mixing and keeping up of the strength of the dips used being under adequate supervision, and the length of time the sheep are in the bath checked by the watch and by no other method.

(2) The provision of adequate baths at selected stations.

(3) The thorough driving of the whole range by parties, each accompanied by an officer of the Local Authority, the first drive to be on the day before the day of dipping.

(4) A second drive, the parties again accompanied by an officer of the Local Authority on the day of dipping to gather all strays not collected on the first drive.

(5) No sheep to be allowed to return to the mountain before the return of all parties from the second drive.

In conclusion I would express my thanks to Mr. Summers, Chief Constable of the County of Pembroke, and to Mr. A. H. Thomas, A.R.I.B.A., County Surveyor, the former for much valued assistance and information and the latter for specially drawing plans of the bath and supplying particulars as to the cost of the work for the purpose of this article.

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GLIMPSES OF AMERICAN HORTICULTURE.

II.

HORTICULTURAL RESEARCH STATIONS.

W. G. LOBJOIT, O.B.E., J.P.,
Controller of Horticulture, Ministry of Agriculture and Fisheries.

Arlington Experimental Farm.—The Federal Experimental Farm at Arlington, near Washington, forms part of an estate which at one time belonged to a member of the family of George Washington, and it is rumoured that in the early days of settlement it was exchanged for a few barrels of tobacco. The land under cultivation has been added to by filling up extensive marshes with dredgings from the River Potomac. The débris is drawn up from the river, and then forced by compressed air through pipes to the site desired.

The apple experiments embrace some seven hundred varieties. Most of the trees were bearing good crops at the time of my visit in May, 1922. There were several examples of pear blight on the pear trees, which were bearing no crop, and none of them looked really healthy. Large collections of roses, irises, and peonies are maintained.

A distinctive feature of the operations is a large installation for cold storage, the object being to determine the extent to which cold storage of fruit can be carried out commercially, especially for grape fruit from the southern states. This fruit, which is usually marketed in the early spring, is nearly over by the time the hot weather sets in. The investigation is to determine whether by cold storage supplies could be held back for a month or six weeks. Fruit was shown to me which had been in storage for three weeks, and during that period had

increased in value by two dollars per box. Another object of experiment is nuts. Walnuts and Peccan nuts are stored after being shelled. The latter, which are grown in the middle western states, are fast becoming an important commercial product. Potatoes were being experimented with, and some were shown me which had been in store for two years. Specimens taken out and planted had germinated.

An important experiment was in progress to determine the temperature at which apples could be preserved for the longest time in good condition, without destroying their flavour. An installation of thermo-couples was in operation for determining the temperature at the heart of the apple. The temperature curve of this was very peculiar, because it showed that while the process of freezing was going on the temperature decreased inwards to the heart, while as soon as freezing was completed the temperature increased towards the heart. I tasted apples of the 1920 crop which had been in a temperature of about 36° F. for two years. They were sound, but quite flavourless. Another experiment was with cut flowers. Specimens of *Lilium Harrisii* which had been in store for eight weeks were in quite perfect condition.

Bel Plant Breeding Station.—A branch of the Arlington Experimental Farm is the Plant Breeding Station at Bel, about twenty miles from Washington. This was the station where the late Dr. Van Peet carried out his well-known work of plant breeding. Raspberries are receiving great attention, particularly black raspberries, and crosses of raspberries and blackberries. None of the varieties I saw seemed to reach the standard of our newer varieties. Strawberries also were not neglected. Specimens of most of the European varieties appeared weak and sickly, and were evidently not happy. The American experiments are made upon a native variety.

Chestnut canker, which is spreading rapidly, and doing much damage among the trees of this valuable commercial wood, is the subject of research, the object being to discover a variety immune from its attacks.

Considerable work is being done by Mr. Darrew on stocks for fruit propagation. The favourite method of propagating these stocks at Bel is not by stock beds as with us, but by root propagation.

Cornell University.—Horticulture is treated as an important subject at Cornell University. On the vegetable trial ground

experiments were being carried out in the control of the cabbage slug. The most successful preventive was a solution of 1 oz. of corrosive sublimate in 8 gal. of water, half a cupful of which was put round each plant five days after planting, and repeated every week for three weeks; a process which may be successful but can hardly be called economically possible for commercial growing.

From Cornell University valuable extension work is carried out, the suggestion for which came from our University extension work, the object being to present farmers with the knowledge acquired by research and experiment at the University. The plan followed is to form community committees in the farming centres, from which a Council of the Committees is elected, which meets annually, and maps out the work for each county. An Executive Committee for a whole State undertakes the administration. Contact is kept up with the farmer by means of County Agents, who are similar to our County Agricultural and Horticultural Organisers. There are women agents to come into touch with the homes of the farmers and spread knowledge of kitchen gardening, home preserving and domestic economy generally.

One development at Cornell is the arrangement by which every grower within the sphere of influence of the University is telephoned to direct when it is the time to begin any form of spraying.

On the extensive fruit plantations of the University several experiments were being carried out. The cultivation was conducted by means of a caterpillar tractor and disc harrow. Pear trees had been pruned to keep them dwarfed, the object being to save labour in picking. So far as could be seen the effect was to produce a bushy tree, rather ornamental, but of decreased fruitfulness.

Geneva Horticulture Station.—At Geneva, New York State, is the famous Horticulture Research and Experiment Station, with Dr. Thatcher as Director, and Dr. U. P. Hedrick as Vice-Director. It is from this Station that the important works "The Apples of New York," "The Plums of New York," etc., have come from the pen of Dr. Hedrick. The records include an elaborate card index system extending to most varieties of fruit, with hand-painted pictures and all data as to characteristics, etc. Fruit breeding is carried out extensively with apples, plums, cherries, peaches, raspberries and gooseberries. The last produce very inferior results at present.

The American gooseberry is miserably small, scarcely bigger than a blackcurrant, and the only European sort that appears to persist at all in the American climate is "Winhams' Industry," which is being used as a parent in an endeavour to get better varieties. Experiments are also being made with wild berries, such as dogwood and elderberry, to endeavour to evolve an edible variety of commercial importance.

Close to Geneva is the city of Rochester, which is the most attractive city I saw in America, and in many respects has ideal characteristics. It has a population of 150,000, and has 1,600 acres of park. Mr. Dunbar, a Scotsman, has been in charge of the City parks for 35 years. He has established an Arboretum at Highland Park, where he has valuable collections of azaleas and rhododendrons, and incidentally he remarked that, on account of quarantine rules, he was unable to replace European specimens of either of these plants when they died. Mr. Dunbar makes a speciality of lilacs, and at the time of my visit a large collection was in full blossom. Many important new varieties are the result of his work.

Near to the city of Rochester there is a large area devoted to the production of vegetable crops for market, and extensive apple orchards. In one of these, owned by a member of the State Legislature, extending to 220 acres in all, dry spraying was in operation at the time of my visit. The formula in use was lead arsenate 15 lb., copper sulphate 5 lb., lime 80 lb. The machine used was a power installation mounted on a lorry drawn by two horses. The powder was forced through flexible steel tubes about 2 in. in diameter. The owner said his men there preferred dry spraying, and he was hoping his experiment might prove a success as he would be glad to do away with wet spraying. He said that the cost of keeping the orchards clear of weeds had been materially decreased since he had adopted the method of discing, the disc harrow being drawn by a Fordson tractor.

Wisconsin University.—The University of Wisconsin at Madison is in the middle of a large dairy country, but it is developing an important horticultural station with a keen staff devoted to research in horticultural problems. Mr. Roberts is giving his attention to the alternate habit in apples. He believes it is a result of the difference in balance between hydrocarbons and nitrates. He showed me apples of the variety "Wealthy" in pots, by treatment of which he was controlling the fruiting. An interesting example of what he considered

to be a proof of the correctness of his theory was four salvias of the "Pride of Zurich" variety. They had been used in an experiment for testing the effect of long and short periods of daylight upon the growth of plants. Those that had been subjected to the long daylight were large and sturdy plants. Those which had been subjected to the shorter light were small and dwarfed. Mr. Roberts had taken these, and had applied nitrate to one of each. That one which had been in the long daylight and had nitrate applied had been thrown into vigorous and succulent growth. The other, which had been subjected to the short daylight, after the application of nitrate had produced abundant flowers. Mr. Roberts was also carrying out experiments in mosaic disease, and he had come to the conclusion that it was largely a matter of temperature. In his opinion the optimum temperature for potato mosaic disease was from 50° to 65° F., while the maximum temperature at which it could exist was 75° F. For tobacco the optimum temperature was 82° to 86° F., and the maximum temperature 97° F. Onion smut had been a subject of experiment, and it was found that treating the land with formaldehyde when drilling the seed was a preventive.

The extension work carried out by this University is on a different system from that of Cornell. Here the County Agents, who are graduates, visit the farmers, and on communication from them an expert on whatever difficulty has to be solved is sent out direct from the University to the farm.

Florida University.—Florida University is situated at Gainsville, a city where the main line of the railway runs along the centre of the main street. One important object of experiment is to discover a grass which will endure in the climate of Florida. Specimens collected from China and Australia are being cultivated. Mr. Berger is here carrying out the culture of parasitic fungi for the destruction of scale. Cultures are made in bottles by the gross, and sold to farmers at three dollars a dozen. Cultivation of citrus fruit is an important industry in Florida, and experiments are being carried out at the University to determine the amount of moisture absorbed by the trees. Huge tanks are used in which the trees are planted, and care is taken to measure them, and the water given. The surplus is drained off at the bottom of the tank and then measured.

It was the writer's good fortune to see the system of fighting the citrus canker in operation. It is well known that

this disease, of Asiatic origin, has threatened the cultivation of citrus fruits with extinction. The spot visited was near Fort Lauderdale, at the extreme South of Florida. It was an affected grove in the "Everglades," a vast area on the confines of the Indian territory which is only sparsely settled. About forty scientifically trained inspectors from all over the State were concentrated there. They lived under real "Wild West" conditions. Each inspector is dressed in white overalls before going into the grove, and on leaving, everything exposed is washed in formalin. Each tree is thoroughly inspected, the affected ones marked, and then follows a party with a flame projector by which the marked trees are burnt to the ground. Afterwards the roots are pulled up by a tractor, heaped together, and burnt. The whole of the soil and the dykes and surroundings are burnt over, treated with formaldehyde, and the place is quarantined for two years. One fine grove of grape fruit just in full bearing was in process of complete destruction —and there is no compensation to the unlucky planter!

One feature of the State organisation of Florida is the elaborate inspection of nurseries which is carried out in connection with the plant quarantine. A copy of every invoice of nursery stock sold in the State is sent to the University and filed. No movement of nursery stock is allowed without a permit, and track is kept of all nursery stock coming into the State from any other State. This involves a most elaborate organisation, and the Quarterly Bulletin of the State Plant Board of Florida gives the number of inspectors and other officers engaged in this work as 102.

Canada.—At Ottawa there is a State Experiment Farm where extensive work is being carried out in investigations upon the degree of resistance of apples to the severe cold of the winters in Canada. Plant Breeding is being done with strawberries and roses, and many types of flowers. Great interest is taken in the question of registration of new plants, and the discussions which have taken place in the Council of Horticulture here have been watched with great interest. The Department there would be willing to co-operate with us if effective measures could be elaborated.

The Canadian horticulturist is a greater believer in legislation than are his confrères here. A Bill was then in progress before the Canadian House of Commons for the establishment of compulsory grading of potatoes and onions, and for the standardisation of packages for vegetables. This Bill has since been passed into law.

A TRIAL OF MOWING MACHINES.

IT is a well-known fact that the mower is of comparatively recent development, and although a crudely designed reaper was in use in a few districts a hundred and fifty years ago, it was used only for cutting the grain crop and was unknown to the majority of farmers. In its general principle of a reciprocating knife passing through a series of slotted fingers the mechanical mower has undergone practically no change since its invention. Such improvements as have been made are of recent date, and affect the details of the independent parts and the method of traction. They cannot be said to have contributed anything in the way of evolving new or improved principles in the machine as a whole. Little, if any, serious investigation has been made in this direction, although there is every indication that work along these lines would be amply rewarded.

The possibilities of the mower have in recent years been decidedly enlarged as a result of the successful introduction of the agricultural tractor. In America, mowers have been devised for attachment to the tractor, and a number of these attachments were introduced into this country after the War. They have attracted considerable attention from the agricultural community from whom numerous inquiries have been received by the Ministry as to their utility. With a view to obtaining some general data as to the performance of these mowing attachments comparative tests have been made of an ordinary horse mower, two-horse mowers drawn by a tractor, and four tractor mowing attachments. The tests took place in July, 1922, at Abbots Hall Farm, Great Wigborough, Colchester, on land placed at the disposal of the Ministry by the courtesy of Mr. H. M. Everard, Terling, Witham, Essex.

Before proceeding to set out the results obtained at Great Wigborough it may be of use briefly to review the general advantages and disadvantages of horse-drawn mowers. First as to disadvantages: the irregularity in the speed of horses affects the quality of the mowing: horses are often pulled up abruptly when a particularly heavy patch of grass is encountered, thus involving backing and restarting and a consequent loss of time and labour: horses cannot be worked for long hours together on a heavy crop, a change usually being necessary at midday.

On the other hand the work done by the horse mower is generally good, whilst the danger of knife-breakage is reduced to a minimum owing to the abrupt stoppage of the horses when an obstacle is encountered.

It was to be anticipated that tractor-drawn mowers and tractor mowing attachments in virtue of their greater capacity and power would overcome many of the disadvantages found with horse-drawn mowers. A machine can be driven at a constant speed for long hours, cut a greater width, and is only slightly affected by irregularities in the density of the crop.

In the tests records were taken of each device under the two main heads: (*a*) economic, and (*b*) mechanical. Under (*a*) the following data were collected:—

Cost of fuel, lubricants and general upkeep in relation to capacity.
Labour, amount and cost.
Cleanness of cutting.
Capacity in acres per day of 8 hours.
Working costs per acre.
Quantity of work done.
Damage done to crop through weight of wheels and equipment of wheels.

Under (*b*):—

Weight of machine.
Drawbar load.
Gear losses and efficiency.
Speed of cutting.
Construction of cutter bar and component parts in relation to efficiency of cutting.
Ratio of knife speed and travelling speed.
Effect of different textures of grass on knife speed. (Time did not permit this test to be completed.)
Effect of moisture on knife parts.

The Test Ground and Scheme of Test.—The land on which the test took place had very prominent stetches and carried a very uneven crop. In consequence the conditions imposed on the machines were severe and were calculated to reveal any weaknesses in design or construction.

The crop was composed of mixed grasses with a preponderance of ryegrass and had been laid down for pasture. It was a rather poor crop yielding from 16 to 20 cwt. per acre, as against the average of 21¾ cwt. per acre for permanent grass in England and Wales.

The machines were worked each on more than one field in order to equalise, as far as possible, the conditions of test.

Results.—

(1) *The "Albion" Horse Mower.*—Manufactured by Messrs. Harrison and McGregor and Co. Ltd., Albion Iron Works, Leigh, Lancs. Price, July, 1922, £30.

The pitman wheel on the Albion machine is driven from a pinion engaging with a toothed wheel rigidly attached to the land wheel. The connecting rod is of iron. A 5 ft. cutter-bar projects from the left and is mounted on small wheels, the height of the inner one of which is adjustable. The cutter-bar is rigid and is fitted with 3 in. centre fingers. It is attached to the main frame by a double jointed concentric hinge which retains the throw of the knife exactly the same from centre to centre at any angle of the cutter. The lifting and tilting levers are conveniently placed, and are easy to operate.*

Total working time	8 hr. 37 min.
Total acreage cut	6·4
Acres cut per hour	0·75
Cost per acre	3s. 4d.

Two horses were required to draw this machine and these were changed at midday for a fresh pair. The horses were worked at a good pace, but were given frequent rests. The time occupied by resting has been included in the total working time. Owing to the rigid construction of the cutter-bar, good cutting could not be done in the furrows when working on the stetched land. This machine showed the highest cost per acre cut, whilst the acreage cut per hour was the lowest. This result was due to the slow speed of travel and the small width of cut, as compared with the tractor-drawn devices.

(2) *Bentall Horse Mower.* (Experimental Machine).—Manufactured by Messrs. E. H. Bentall & Co., Malden, Essex. Price, July, 1922, £30. Fordson tractor, £120.

During the tests two types of Bentall machines were used, one of the standard and the other an experimental type. The chief difference between the two machines was that the experimental machine was lighter and the caster block was mounted with the ring cover.

A 4 ft. 6 in. cutter-bar is mounted on runner wheels, and is placed on the right hand side of the machine, well under the observation of the operator. The lifting and tilting levers are easy to operate. A foot clutch is provided for engaging the gears.

The drive is obtained by spur and bevel gearing from the main axle, and the pitman wheel actuates the knife by means of an iron connecting rod. Ample provision is made for lubrication.

Total working time	4 hr. 18 min.
Total acreage cut	4·7
Acres cut per hour	1·09
Cost per acre	3s. 2d.

This machine was drawn by a Fordson tractor, and required a mowing operator in addition to the tractor driver. The cost of this method was high and only a small acreage was cut per hour, but the quality of work done was excellent. The results obtained in the test must not be regarded as a reflection upon the design of the machine, but rather as a proof that under the conditions of test, the use of a single mower drawn by tractor is not economical.

* A detailed description of each machine is not given as the reader will be familiar with the general constructional details of the modern mower. Reference is made solely to special features.

(3) *Bentall's Horse Mowers (Two Machines).*—Hitch manufactured by Messrs. Kingdon & Co., 105, Whitecross Street, London, E.C.1. Price, June, 1921, £4 12s. 6d.

A Bentall standard and an experimental type machine were coupled together by means of a Kingdon hitch and drawn by a Fordson tractor.

Total working time	5hr. 17min.
Total acreage cut	13·1.
Acres cut per hour	2·48.
Cost per acre	1s. 11d.

Six inches were allowed for overlapping, so that altogether the width of cut was 8 ft. 6 in. The tractor proved easily capable of hauling the two mowers, but there was awkwardness in turning corners. The hitch permitted the drawbar of the second machine to drop and the fingers of the cutter-bar on the rear machine had therefore a tendency to dig. Both mowers did excellent work, but owing to the speed at which they travelled the bearings became hot and frequent lubrication was necessary.

The high speed of working and the great width of cut more than set off the cost of the extra labour required. Subject to there being a sufficiently large acreage, there is no doubt that where a farmer owns two mowers, and a tractor, good results can be obtained by employing them in this manner.

(4) *The Cutmore Mowing Attachment.*—Manufactured by the Roderick Lean Manufacturing Co., English representatives: Messrs. A. Dugdale Ltd., 65, Conduit Street, London, W.1. Price, July, 1922, £34 10s.

The Cutmore mowing attachment is constructed solely for use with a Fordson tractor. The 6 ft. cutter-bar projects on the right side, midway between the front and rear wheels. The pitman gear is actuated by an enclosed shaft, driven in its turn by a chain from the main worm shaft at the rear of the tractor. A cover effectively prevents the pitman wheel from becoming choked by grass. The cutter-bar is fitted with 3 in. centre fingers, and a clearance of about 1/16 in. is permitted between the finger and the blade. Six arched wearing clips are provided. The cutter-bar runs on two shoes and levers are provided for lifting and tilting it. The clutch lever for engaging the mowing attachment is conveniently placed. In the event of the cutter-bar encountering an obstacle, a wooden safety peg on the drag bar is broken, which causes the tractor foot clutch to be withdrawn and so prevents damage to the cutter-bar.

Total working time	15 hr. 3 min.
Total acreage cut	23·7
Acres cut per hour...	1·58
Cost per acre	1s. 11d.

The knife speed of this device was comparatively slow, and in consequence it was found necessary to run the tractor fast in order to obtain efficient cutting. The cutter-bar was flexible and followed the contour of the ground very closely. On rough ground the wooden safety pin was broken very frequently, and a larger pin might be used without risk of damage to the attachment. The lifting lever was not easy to operate. The nuts required frequent attention, as the vibration of the tractor caused them to work loose.

The Cutmore cut a greater average acreage in the hour than any of the other tractor mowing attachments.

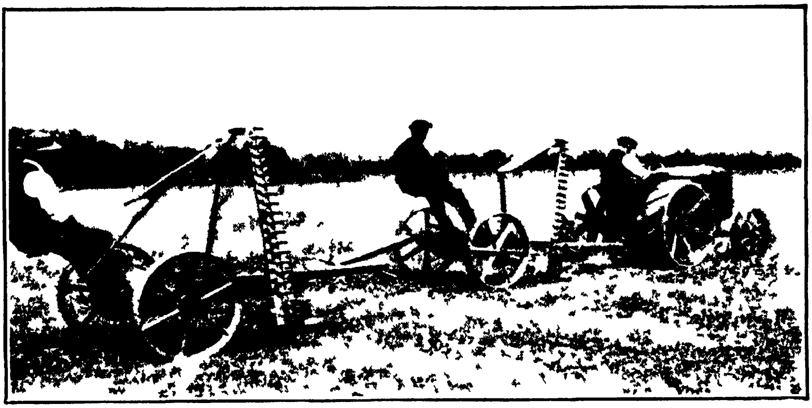

FIG. 1 Tw Bentall Mowers c upled by Kin lon Hitch

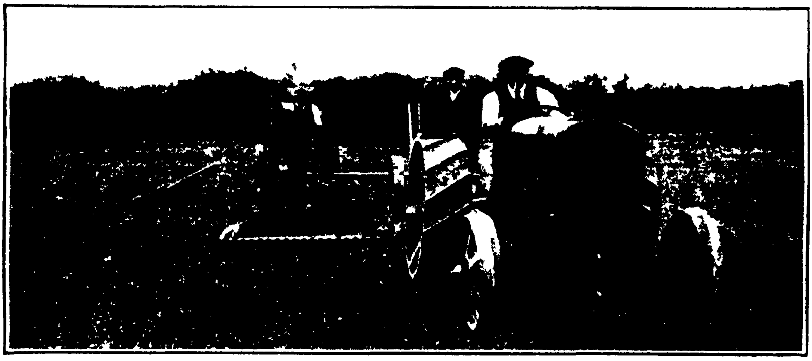

FIG. 2 Two Bentall Mowers upled by Kin l n Hitch

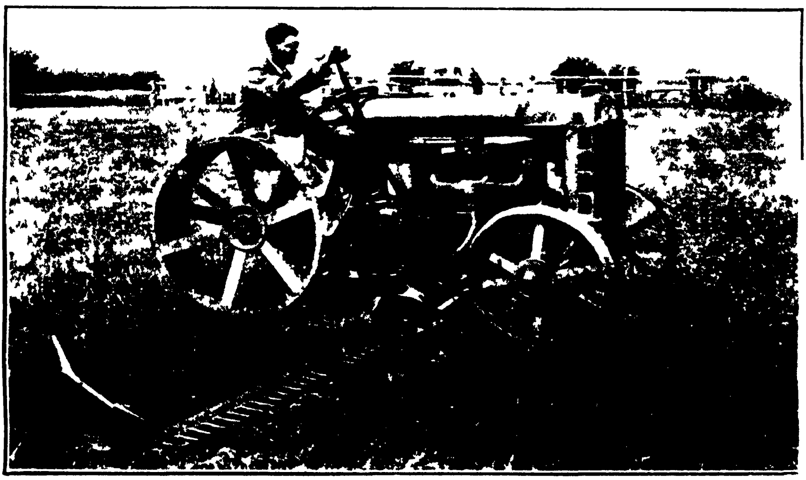

FIG. 3.—The Cutmore Tractor Mowing Attachment

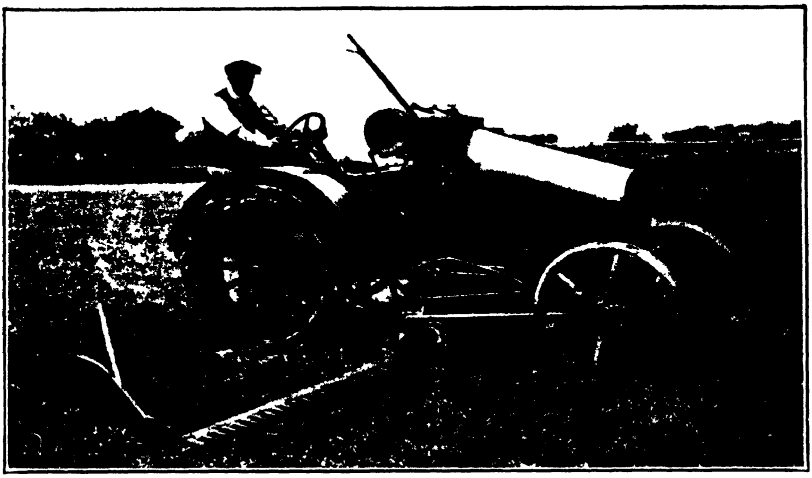

Fig. 4.—The International Tractor Mowing Attachment.

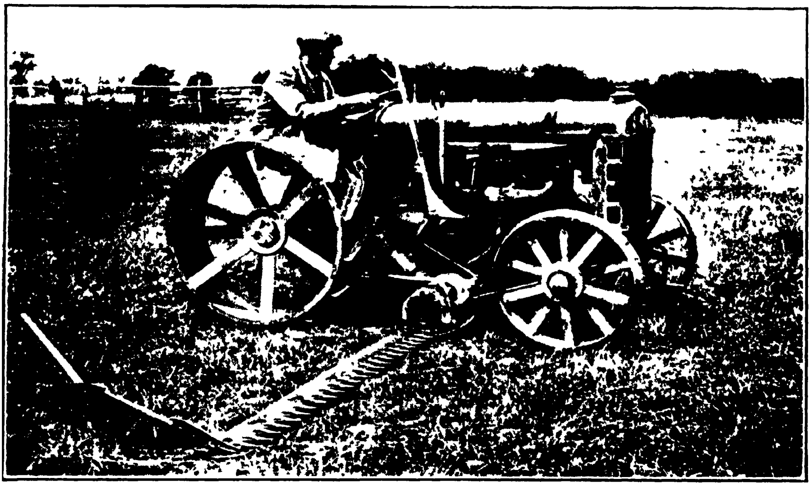

Fig. 5.—The Otwell Tractor Mowing Attachment.

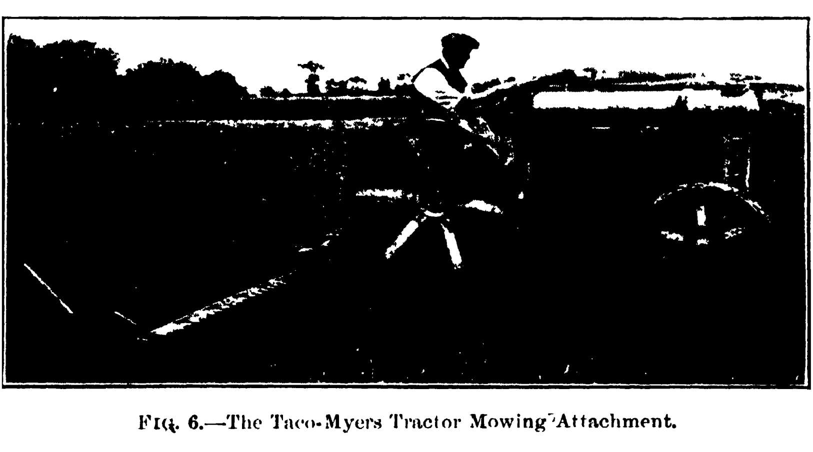

Fig. 6.—The Taco-Myers Tractor Mowing Attachment.

(5) *The "International" Tractor Mowing Attachment.*—Manufactured by the International Harvester Co. (Great Britain) Ltd., 80, Finsbury Pavement, London. Price, July, 1922, £37 ; Tractor, International Junior, £250.

This attachment is constructed solely for use with the International Junior Tractor and has a 7 ft. cutter-bar. The pitman wheel is placed on the left hand side of the tractor and is driven from the main transmission shaft. A wooden connecting rod operates under the tractor, while the cutter-bar is placed on the right hand side midway between the front and rear wheels. The cutter-bar runs on two shoes and is fitted with 3 in. centre fingers. Two levers are provided, one for lifting, the other for tilting the cutter-bar.

Total working time	6 hr. 3 min.
Total acreage cut	7·3
Acres cut per hour	1·21
Cost per acre	2s. 11d.

Very good cutting was done with this attachment on level ground, but on rough ground the fingers on the cutter-bar dug in, owing to the tilting lever not having sufficient movement. The lifting lever was awkwardly placed and difficult to operate and it was necessary for the tractor driver to leave his seat in order to reach it. In consequence it was impossible to take full advantage of the speed of this tractor.

(6) *The Otwell Tractor Mowing Attachment.*—Manufactured by the Otwell Mowing Company, 6538, Livernois Avenue, Detroit, U.S.A.

The Otwell attachment is constructed solely for use with a Fordson tractor, but differs from other Fordson attachments inasmuch as the pitman wheel is driven by means of an enclosed shaft from the pulley shaft. The whole attachment is placed on the right-hand side of the tractor, and the cutter-bar projects midway between the front and rear wheels

Total working time	8 hr. 36 min.
Total acreage cut	12·9
Acres cut per hour	1·51
Cost per acre	1s. 10d.

The cutter-bar on this attachment was not very flexible, and consequently good cutting was not done in the furrows. The pitman wheel was a great source of trouble, as owing to its position close to the ground it was frequently choked with grass and the bearings became hot. The spring suspension of this attachment was very good.

(7) *The Taco-Myers Tractor Mowing Attachment.*—Agents—The Tractor Appliance Company, 58, Middlesobro' Road, Coventry. Price, July, 1922, £45.

This attachment is constructed for use with a Fordson tractor. The pitman wheel is mounted on a shaft which forms a continuation of the worm shaft of the tractor, a very simple drive being obtained by this means. The cutter-bar is placed on the right hand side, to the rear of the tractor driving wheel. The 6 ft. cutter-bar is very flexible and the whole method of suspension very good.

Total working time	11 hr. 15 min.
Total acreage cut	17
Acres per hour	1·51
Cost per acre	2s. 6d.

The acreage cut by this attachment was high, while the excellent suspension and flexibility of the cutter bar enabled very close cutting to be done.

Though a simple drive is obtained by placing the attachment at the rear of the machine, this advantage appears to be more than offset by the fact that the tractor driver is compelled to look back to observe the work done. The clutch for throwing the mowing gear in and out of action was found to be inaccessible to the tractor driver. The lifting lever required great exertion to operate it, and in addition was set too close to the tractor wheel. The pitman wheel frequently became choked with grass owing to its closeness to the ground and lack of protection.

Economic Results.—The principal economic factors to be taken into account in estimating the relative cost of the various machines tested are (*a*) Capital cost, (*b*) Labour required, (*c*) Width of cut, and (*d*) Speed of cutting.

The prices of the various mowing devices varied from £30 for the horse mower to £45 for the Taco-Myers tractor attachment. The mowing machine (as distinct from the tractor attachment) required one man when drawn by horses, two men when drawn by tractor, and three when the double unit was drawn by a tractor. On the other hand, only one man was required throughout with the tractor mowing attachments. The width of cut and the speed of cutting enabled every tractor attachment to do nearly double the work of the horse drawn mower.

While there was found to be no substantial (if any) advantage in operating a single mower with a tractor rather than with horses, it was clearly substantially cheaper to operate two mowers by tractor, or to use a tractor attachment. Between these two methods of employing a tractor there is probably little difference in cost in the long run, but the saving in capital cost when only an attachment has to be purchased is nevertheless an advantage, and there is the further consideration that every reduction in the items of machinery on the farm, so long as there is no loss in efficiency, tends to a reduction in overhead expenses.

It will be recognised when examining the figures of cost per acre contained in the table that while they give a general indication of the relative cost of each method they do not give a precise indication of the relative economy of the various devices. A margin must be allowed for experimental error, and a difference of a few pence is not significant. Moreover, the particular conditions under which the test took place have to be allowed for. Owing to the width of cut the tractor wheels ran on the previously cut swath. Actually in the test no difficulty from this cause was experienced in the subsequent operations, but it is considered that if the land was soft the strakes on the tractor wheels would force the grass into the ground and hinder subsequent operations.

(To be concluded.)

CREDIT FOR AGRICULTURISTS.

THE Report of the Committee appointed by the Government to inquire into the question of Agricultural Credit has now been issued. The Committee consisted of Sir Theodore G. Chambers, K.B.E., Vice-Chairman of the National Savings Committee (Chairman), Sir Francis Floud, Secretary, Ministry of Agriculture and Fisheries, Mr. H. M. Conacher, Deputy Commissioner, Board of Agriculture for Scotland, and Mr. A. W. Hurst, of the Treasury.

It is pointed out in the Report that the cultivation of the ground, including the harvesting of crops and the rearing and management of live-stock, is not only the oldest, but the most widely dispersed occupation of civilised man. The interval between seed time and harvest, between the rearing and killing of beasts, probably necessitated in the earliest times the use of some system of credit. Indeed, it may be assumed that agriculture gave birth to the conception of credit. It is therefore natural that credit should have come to be regarded by the farmer as an essential element in the productive process. Although there has been a tendency in most countries to isolate "agricultural credit" and to treat it as a peculiar credit problem demanding special consideration, fundamentally credit plays the same part in agriculture as in any other industry. Credit has been aptly defined as the means whereby the transfer of wealth from one person to another is effected for a period of time, at the end of which it is restored to its owner. Credit cannot directly increase the actual means of production which are potentially at the service of mankind, but credit machinery can and does transfer from one individual to another the right to use these means, and it is therefore both natural and relatively accurate from the individual point of view to regard credit as an important agent in the productive process. Nevertheless, credit is merely another name for someone else's money.

Classes of Credit needed.—The credit requirements of agriculturists are divided into :—

Long-term credit.—(*a*) For landowners, to be used in productive capital works, (*b*) For tenant farmers purchasing their farms.

Short-term credit for farmers to meet current outgoings and to facilitate the production and marketing of their products.

Long-Term Loans for Capital Works.—This form of credit is already available under State control, through the Lands Improvement Company, which was formed in 1853 for making loans to landowners for such improvements as drainage, reclamation, the erection and extension of farm buildings and cottages, silos, etc., and the provision of water supply. Applications for loans from the Company must be approved by the Ministry of Agriculture or the Board of Agriculture for Scotland. The loan is secured by a mortgage upon the property improved and is repayable by annual instalments over a period of 15-40 years according to the nature of the improvement, with interest at 4½ per cent. net, after deduction of income tax, which represents at present a gross rate of about 6 per cent. In view of the first-class nature of the security, credit flows easily into the business and the resources of the Company are therefore practically unlimited. The Company advanced some £13,000,000 during 70 years but during the War its business was practically suspended, partly owing to the rate of interest chargeable on loans being limited by law to 5 per cent. In 1920, however, the Company obtained an amending Act replacing this maximum by such rate as the Ministry of Agriculture may approve, and its business has revived, small owners, moreover, now making more use of the Company than formerly. The similar Scottish Company, and any others which may be started are still restricted to 5 per cent.

The Committee considers that no method on an economic basis for the provision of capital for permanent improvements would be more advantageous than that described above, and recommends that the Improvement of Land Acts should be amended to empower any association operating under those statutes to charge such rate of interest as the Ministry of Agriculture or the Board of Agriculture for Scotland may approve. It also recommends that the Lands Improvement Company should be urged to consider the means of bringing the scope and advantages of its operations more prominently before the notice of the owners of agricultural estates in Great Britain than is the case at the present time.

Long-Term Loans for Land Purchase.—There is a further class of long-term credit demand which has been accentuated by the peculiar circumstances of those tenant farmers who, having purchased their holdings during recent years, now find themselves in consequence short of working capital.

In 1922 the number of holdings owned by their occupiers was 13,500 more than in 1914, the increase in acreage being

1,700,000 acres. The majority of these purchases took place between June, 1919, and June, 1921. High prices were often paid, and there is, in the Committee's opinion, little doubt that in certain individual cases purchasers were directly influenced by the Corn Production and Agriculture Acts, if not actually to embark on ownership, at any rate to pay a higher price for their farms than in other circumstances they would have been prepared to offer.

The owner-occupier is in the same position as the landowner in that he has, in his land, an absolutely first-class security to offer. The difficulty, however, in his case is that no adequate machinery has been established in this country for the purpose of granting long-term loans on real estate of which tenant farmers who have bought or wish to buy their holdings can avail themselves, and, consequently, a large number of the new owner-occupiers in the country have pledged their title-deeds as security for temporary loans of uncertain duration which they raised in order to complete their purchases.

The Committee recommend that those farmers who purchased their holdings between the date of the passing of the Corn Production Act, 1917, and the Corn Production Acts (Repeal) Act, 1921, should be enabled to obtain loans by an approved Society operating under the ægis of the State, such loans not to exceed 75 per cent. of the present value of the holding concerned and to be repayable within a period of 40 years on an annuity basis. Funds for this purpose to be advanced in the first instance by the Public Works Loans Board and, subsequently, by the issue of guaranteed stock.

Short-Term Credit.—This represents the main problem of agricultural credit. Credit for a comparatively short period is often of assistance to farmers for the purchase of seeds, fertilisers, feeding-stuffs, seasonal stock and equipment, and for the purpose of enabling them to arrange the systematic marketing of their produce. In the nature of things, loans are also needed by farmers in the course of their operations for purposes which are not strictly seasonal, in the sense that the period necessary to secure for the farmer a turnover on the outlay involved may extend from one to five years. The main purposes for which accommodation of this nature is required are for the initial purchase by breeders and dairy farmers of foundation stock, the purchase of machinery and implements, and the execution by tenant farmers of minor improvements such as additional fencing or drainage, or the erection of silos and Dutch barns.

Improvements of this nature have frequently to be undertaken by tenants owing, in many cases, to the reluctance of landowners to impose further charges on their estates.

The Report deals at length with the existing facilities for short-term credit, *e.g.*, (i) banks, by means of loans or overdrafts on accounts, and (ii) auctioneers, seedsmen, manure-merchants, traders, dealers and private money-lenders, and points out that there are certain gaps in the facilities available, viz.: (*a*) credit for agriculturists who for various reasons have not effective access to present day banking facilities; (*b*) credit for the purchase of live stock, etc.; (*c*) intermediate-term credit required for a few years to enable a tenant to improve the equipment of his farm, by, for example, the purchase of permanent breeding stock, provision of equipment, machinery, fencing, drainage, etc.

To meet the need for short-term and intermediate-term credit the Committee make the following recommendation:—

"We recommend that the State should encourage the immediate formation of Agricultural Co-operative Credit Societies, and should place a capital sum at the disposal of each Society on the basis of £1 for every £1 of share capital raised by the Society, of which not less than 5s. in the £ shall be paid up. These Societies to be affiliated through the Ministry of Agriculture or the Board of Agriculture for Scotland, to be allowed to receive deposits and to be given a free discretion as to the granting of loans to members for agricultural purposes. We further suggest that the State funds employed for the purpose of the scheme should be derived by the application of a portion of the money derived from the sale of Savings Certificates in rural areas."

The Report (Cmd. 1810) in full can be obtained from H.M Stationery Office, Imperial House, Kingsway, London, W.C.2, Price 9d.

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FARM BUILDINGS FOR SMALL HOLDINGS.

MAJOR H. P. G. MAULE, D.S.O., M.C., F.R.I.B.A., and
A. EWART ASTON,
Ministry of Agriculture and Fisheries.

IN the *Journal* for May and June, 1922, articles were published on farm buildings for small holdings dealing mainly with the single roof types erected by the North and West Riding County Councils and a somewhat similar type erected in Durham.

The present article continues this series and deals with a very interesting single roof building designed and carried out by Mr. A. P. Ker for the Northumberland County Council. From the direct and simple nature of the plan and construction, this building lends itself admirably to standardisation, and is so planned that it is particularly adaptable for the varying needs of small holders. For this reason an alternative scheme is illustrated, giving the general lines upon which such standardisation and adaptation might take place were the building required for a dairy holding.

Those who have followed the articles on farm buildings referred to will readily see that Mr. Ker's design is very similar in principle to the general lines advocated in the *Journal* for the construction of cowsheds and covered yards, and the authors have therefore ventured to link up the various points of similarity in order to produce a scheme which it is hoped combines the best and most practical features of each method.

The Northumberland Plan.—The Northumberland plan was originally designed for 50-acre holdings on the Hexhamshire Estate of the County Council and included the following accommodation :—standings for 10 cows, a hemel or covered-in yard for 10 beasts, stabling for 2 horses, a loose box, mixing floor and cart-shed with loft over, the whole being included under one single span roof carried on built-up small-member trusses identical in principle with those used at the Ministry's Arable Dairy Farm at Hucknall The roofs were covered with slates, probably the most suitable and convenient roofing material in the district, though in other situations some form of asbestos sheeting would almost certainly give the cheapest and most practical results. The plan is so arranged that it

See this *Journal*, July, 1922, "The Planning and Construction of Cowsheds."

can be adapted to suit almost any aspect by interchanging the internal compartments without interfering with the general structure of the building.

It will be seen from the illustrations that every part of the building can be reached internally for feeding purposes by means of the central feeding passage from the barn or general food store, which is placed at one end of the long axis, thus giving access to stable, loose box, cow-standings and hemel. The openings into the hemel can be closed up during the winter months by the use of loose boarding, and this space can equally easily be turned into extra standings for cows, if required, and at small cost.

In actual practice, Mr. Ker has found that these openings make the buildings too cold in winter, and doors have since been provided. Another improvement suggested by Mr. Ker is to make the loose box larger, namely, about 18 ft. 6 in. instead of the 15 ft. shown on the plan, and by placing the doors, both external and internal, in the centre, space is made for the provision of two small boxes on each side of the 2 ft. 6 in. central gangway between the doors. These boxes could then be used for calves or pigs, making four boxes in all, each about 8 ft. by 7 ft. 6 in., the tenants providing the box division walls. This appears to be a very practical improvement to the original plan.

A further advantage of this type of building (also advocated by us in the article on cowsheds) is that if the site is sloping, the different compartments can be arranged to meet this contingency by stepping the floor levels, either in cross-sections or longitudinally, in which latter case the central feeding passage would follow the general level of the ground. Extra cost could be avoided by starting the buildings at the higher point of the site with the eaves at about 6 ft. from the ground level, sufficient head-room to back in carts and allowing ample head-room lower down the site for the various side entrances to stable, loose box and hemel.

Provision is made for loft space over the cart-shed and barn, and this space could be extended, if desired, though possibly at a higher level, over the stable and loose box.

These Hexhamshire buildings were constructed of timber grown on the Estate, oak being used for the walls and wall studding, doors and frames, and larch and Scotch fir for the roof timbers. The building is lighted by means of glass slates provided in the roof at intervals and at the eaves, where a

transom light and shuttered opening is provided to each alternate bay. A concrete base, in which the main oak supports are inserted, is provided to a height of about 18 in. above ground level, thus preserving the timber walls from damp and premature decay.

Particulars of Cost.—Five sets of these buildings have been erected under a contract at £872 7s. 0d. per set, the contract including the provision of the necessary roads, fences, installation of water from adjacent mains, and sewage disposal, which last includes a liquid manure tank with a capacity of 500 gal.

The Council had all the timber for these buildings cut to the scantlings required out of timber grown on the Estate, and it was supplied to the contractors at the Estate yard at the following rates per cubic foot:—oak, 3s. 9d.; larch, 3s.; and Scotch fir, 2s. 6d. The sites of the several blocks of buildings ranged from one-quarter to one and a half miles from the yard. The Hexhamshire Estate lies some 7 miles from a railway station, remote from any village and little local labour or accommodation was available, and it is estimated that under more favourable circumstances the cost would have been reduced to £800. Sand and gravel were provided to the contractors free of cost at a gravel pit on the Estate.

The plan (Fig. 1) and the photographs (Figs. 2 and 3) give a very good idea of this extremely serviceable building, and the Northumberland County Council are to be congratulated on their enterprise in departing from the normal quadrangular plan.

Suggested Modifications.—In Fig. 4 a plan and section is given showing the suggested standardisation and certain modifications of Mr. Ker's plan adapted for the purpose of a dairy holding.

This plan shows that each bay or unit of the building is now spaced at 10 ft. 6 in. centres in order to synchronise the spacing of the animals with the spacing of roof trusses as was shown in the former articles on cowsheds. There are certain obvious advantages in this arrangement. The construction and the provision of standings are simplified the supports now go directly under the trusses and between each group of three cows, extension is particularly simple and an addition of one or more bays gives a corresponding increase for an exact number of animals. The feeding passage has been increased to 5 ft. as being more convenient for serving the double row

of cows now shown in place of one set of single standings and the hemel.

Another variation is the provision of direct access from the cowshed to the loose box and stable, which have been arranged so that both are readily convertible either to cow standings for four cows in each or for two smaller boxes on each side for calves or pigs. The doors have been arranged on plan to give a through access from side to side of the building either to boxes, cow standings or stable as the case may be. Thus in

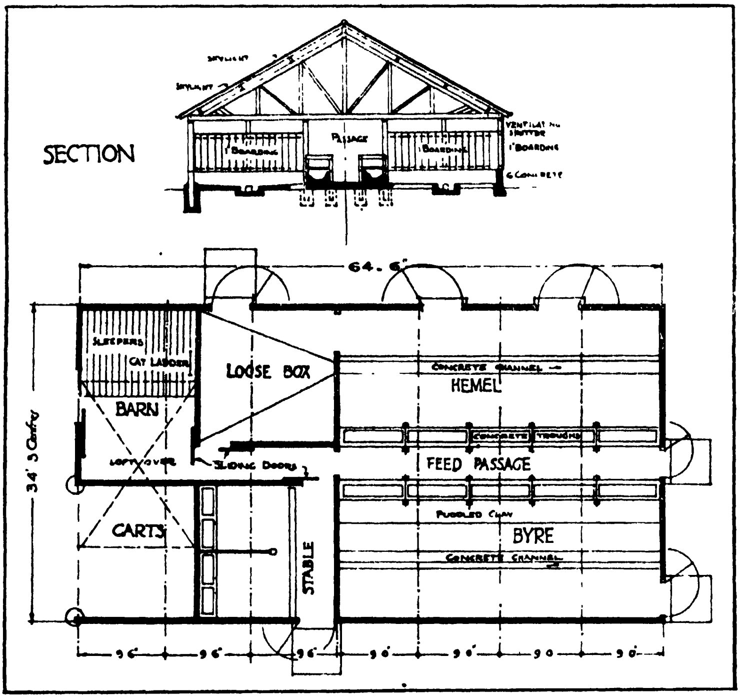

FIG. 1.—Plan and Section of Farm Building at Hexhamshire, Northumberland.

the event of an open yard being placed on either side of the main axis, there will be ready means for dunging out into this yard from every occupied part of the building. The provision of communication between cowhouse and boxes would certainly be convenient for moving a sick animal and need not be used unless required.

The cart-shed and barn are very much as shown on the original plan, but provision is made for internal access to the loft, which, continued over the stable and loose box, would give more ample storage accommodation demanded by the

FIG. 2 Front view of Farm Building at Hexhamshire

FIG. 3 —Interior view of Farm Building at Hexhamshire.

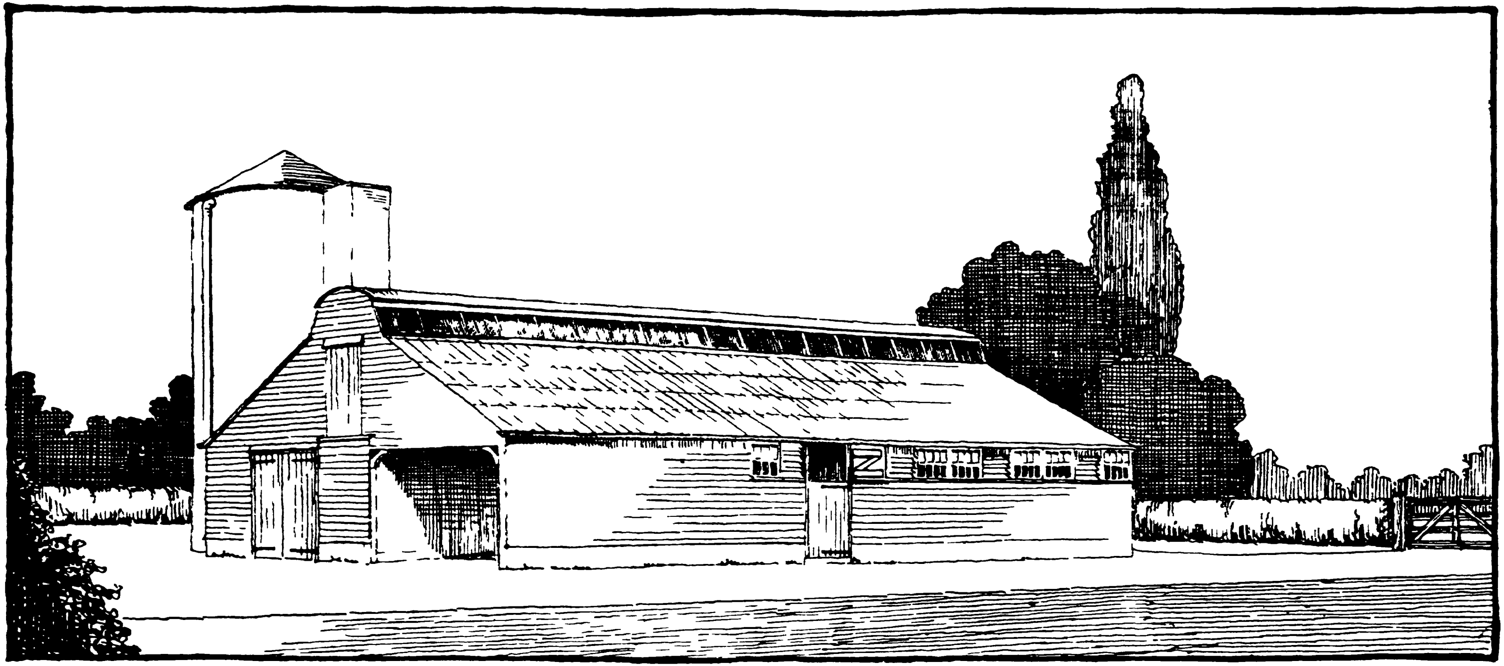

FIG. 5.—Perspective view of suggested Standardisation of Hexhamshire Farm Building.

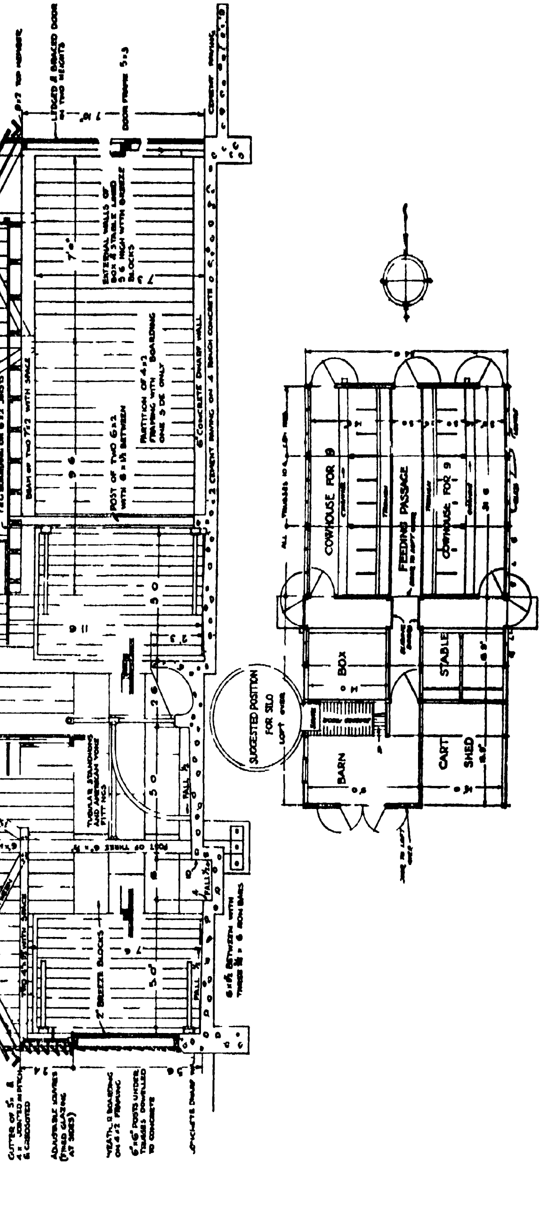

FIG 4.—Plan and Section of suggested Standardisation of the "Hexhamshire" Farm Building.

increased head of stock. The cart-shed space can be utilised to accommodate a tractor, which would operate shafting secured to the back wall of the cart-shed and barn for working machines either on the ground floor in the barn or in the loft above.

Provision of Silo.—The plan indicates where a silo could be conveniently situated so as to deliver direct on to the boarded floor of the barn, and where it would not interrupt any extension of the building by the addition of one or more bays at either end.

Construction.—The revised scheme shows the same type of timber construction advocated for large cowsheds described and illustrated in the articles published in July and August last. In this case the construction has been utilised to form continuous top light and ventilation, thus enabling the remainder of the roof surface to be covered without cutting the material for sky-lights. The advantages of this method were described in the former article, and in the event of some form of corrugated sheeting being used for the roof, would undoubtedly be a material improvement. The construction is practically the same throughout, except that there are slight modifications in the internal members of the roof trusses where these occur in the loft in order to make more space and head-room.

Cost.—The complete building without the silo cubes out at 33,200 cu. ft. and at present prices in a reasonably good building locality should not cost more than £1,000, or a fraction over 7d. per cu. ft. This estimate, however, does not include special fittings or machinery. It should be noted that the Hexhamshire estimates were for five buildings and that the contractor was provided with special facilities for getting certain materials on the site and on favourable terms.

We cannot conclude this article without expressing our thanks to Mr. Ker for his kindness in supplying plans and information, and we hope that the illustration of the Northumberland building and the suggested amendments will prove of value to practical farmers.

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THE AYRSHIRE COW.

MISS A. D. BRIGHT.

THE Ayrshire, the essentially Scotch milch cow, a few years ago was something of a stranger among southern show-goers, so that on both sides of the Border it was almost forgotten

that before Waterloo this dairy breed was in great demand in all parts of Great Britain. Quite recently there were show-goers in England who regarded this breed as almost an alien. Only three years ago the pedigree Ayrshire, her performances and her special attributes, had little interest for frequenters even of the big shows, while there were parts of the south and west of England to which she rarely penetrated. "She is a poor man's cow in Scotland" was a comment overheard at the 1921 London Dairy Show, "and she would not at all suit good English pastures."

The Ayrshire, one of the best of cows for poor land, is not by any means exclusively a poor man's cow. "She is a verra sound commerical proposee-tion" drawled one of her successful breeders, when the so often quoted remark was made in his hearing, "and she is mebbe a guid beast for a puir man, for if she taks him in haun, he needna be sae puir for lang."

After seeing her at home, or as she appeared at the Royal Shows of 1921 and 1922, the visitor to Ayr pastures has ground for some surprise that the Ayrshire is still undoubtedly within the reach of modest means, and that it is possible for small men to maintain excellent families of the breed with their places in the Herd Book, even though notables among pedigree stock are in demand with buyers who pay record prices in four figures. This is possible because it is difficult to escape pedigree in an original breed, living so long in its own counties that selection is easily watched.

Though in Scotland as in England, there have been introductions of Dutch blood, the Ayrshire in her evolution is essentially Scotch, closely resembling no other British breed and no European one. She was Scotch as the Kylo in 1793, as one of the "Black Cattle" in 1806, as the Dunlop in 1814, and as the Cunninghame a year or two later. By the middle of last century when she was simply the Ayrshire she had changed her colours and markings several times, but in appearance, in attributes, in disposition she was as purely Scotch still as the successful farmers on whose acres she had been evolved. No breeding seems to bring her to the English Shorthorn type, although the effect of the Ayrshire cross very often will give the Scotch model to an English herd.

The Ayrshire is still developing and in her development she affects striking colours. Chiefly now she is white with brown cheeks, or white with brown markings on cheeks and body. In one phase she passed through she was too undeveloped to be

easily milked, but she is to-day one of the most beautifully formed of milch cows, and during twenty years of milk recording has developed milking powers together with a uniformity of outline and conformity to type that would astonish those breeders of the Kilmarnock Farmers' Club who first set themselves to improve the national breed.

It is not claimed that the Ayrshire cow is a phenomenon; in milk production she does not rival the Friesian; in butter fat production she is not equal to either of the Channel Island breeds; but there is no cow in Britain that has done better on sparse pasture. There is no cow in Europe that more quickly adapts herself to extremes of climate or to changes of conditions. This hardihood became hers in the infancy of the breed when the south-western counties of Scotland had not developed into the smiling countryside of to-day, and it is maintained by the bracing climate and conditions that still rule in her homeland.

The world over, reliability is recognised as distinguishing the production of the Ayrshire. She is hardy and tractable; she is built on a very fine model and her performances are as good as her lines. In Canada and the Kenya Colony, in Finland, in China, Sweden and New Zealand, she thrives on second-class land and improves the yield of second-class herds. She was established as a favourite in Australia years ago, and though, through causes which no longer exist, the breed for a period lost ground, it is now recovering popular favour rapidly.

As a family or as a herd the Ayrshire has not yet equalled the performances of the greatest Friesians; it is doubtful whether centuries of breeding could give her the elegant lines of some Jerseys, or the handsome Shorthorn head. It is absurd to compare and contrast the Scotch cow with the Friesian, the Dairy Shorthorn, or the Jersey, or to declare one breed finer than another. Each geographical district confers on its own herds and flocks special attributes. Still the Ayrshire's head is a fine one—none more intelligent—and her lines, while proclaiming her milking powers, make her particularly alert. Her performances at the Shows in 1922, especially the London Dairy Show and the Royal Show, at which she competed with English herds, tell a tale of milking powers that is not only interesting but immensely illuminating, both as regards the breed itself and as touching the value of consistent and systematic milk recording, of which her present fine uniform average yield is the result. As a whole, at those two shows

no exhibit did what they set out to do more consistently than the Ayrshires. The breed essayed to prove itself in the milking trials, and at one show out of 15 Ayrshires entered for the milking trials, 12 actually competed, and of these none failed to pass the necessary tests for butter fat.

Again, in those same trials, out of the nine of one breed competing, only three got through the test; out of another six only two emerged with honour; while every heifer in the Ayrshire section received her card—an achievement that is probably unique. That an Ayrshire took the championship in her own class (Grade B) with a total number of points not attained by any member of four of the breeds in Grade A, was pleasant news for the exhibitor. Such individual performances, however, have not much educative value; exceptional beasts give no more data as to the potentialities of a breed than does exceptional genius offer any guide as to the mentality of a nation. When combined performance becomes exceptional and when such combined performance is repeated, here is achievement that has a lesson for every looker-on.

The Ayrshire, however, in her individual performances, is not uninteresting. She has attained the 2,000-gal. limit (milked twice a day) in America as well as on her home pastures. She has not lost the habit of her grandmothers of producing a calf every year. Her milk is specially adapted to the making of cheese, and in London Ayrshire men secured most of the honours for Cheddar. Again, however, the usefulness of the breed is not to be found in pedigree herds alone, nor are its praiseworthy performances to be recorded only from these.

Ayrshires were represented in 1921 at the London Dairy Show by two cows, one of them picked up in open market in Ayr just in time for entry. She came her 500-mile journey in fine condition and was in all ways a singularly attractive little beast (non pedigree) with an inquisitive, clever head and alert movements that made her particularly noticeable in that hot, October week. A big entry of any class at the London Show brings with it a certain number of show-goers, and most of the British representative breeds had their attendant owners. The Ayrshire apparently had none, but she had food, which in spite of the heat she never ceased to chew, and all the while, as she munched, she kept turning her head, here, there, everywhere. She was not in the last perturbed by her surroundings, but her inquiring eyes had to see all that went on. She came

fourth in the milking trials that year against all comers—Friesian, Dairy Shorthorn, Red Polled, etc.—without any preparation and with no particular care at a time when the railway journey was not so well managed as it is now. Seeing this, it is not at all certain that her performance was not as good as that of many of the pedigree Ayrshires coming to London in 1922.

Visitors to Baltic lands agree that the great usefulness of the many dairy competitions in Denmark is to be looked for in the standard they set, not to be maintained but to be trodden down. Always a record is made to be broken, and this again not by single members of individual herds but by the whole country in its national and amazingly representative average. In this ambition of the Danish dairy farmers the men of the Ayrshire counties join issue. Never was a 2,000-gal. cow less advertised than Tosh, who made that record, has been. She is not even specially shown at the Hobbsland Farm. For here and in most neighbouring establishments great milkers can be found, giving, year after year, results quite as satisfactory without the element of danger that attends abnormal yields.

The district of the Ayrshire cow, the standard of efficiency maintained at the byres where she is milked, and her performances as recorded at the Shows should be studied together. When taken separately, with one exception, these aspects in her evolution lose significance. The exception is her appearance in one of the events of the February Show at Ayr, entailing a far severer test than any faced at bigger functions. This was the parade of the 1,000-gal. cows. In this class, sixteen entries, all certified to have produced over 1,000 gal. of milk averaging not less than 3.5 per cent. of butter fat in any one lactation, exhibited such uniformity that at the end of the row number sixteen would have made an excellent second if the intervening entries had not been in their places. Very few Southerners were present, which was a pity, for no British farmer, whether Scot or Englishman, could fail to be proud of this extraordinarily noble assemblage of splendid milch cows, as essentially British in character as are the contours of the countryside that produces them.

Without any unique performance, however, the Ayrshires, whether appearing at shows, or in milking herds at home, or as crosses facing hard conditions in overseas lands, are now happily recognised by English critics as " a very good lot," and it is realised that in the interests of progress, the breed should

not be overlooked anywhere where excellent performance is to be provided at the minimum of cost on lands that, at their best, are only medium.

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FRIT FLY ON OATS IN THE FOUR NORTHERN COUNTIES.

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IT is only during recent years that farmers in the north have begun to realise the magnitude of the losses in the oat crop caused by the larvæ of the Frit Fly (*Oscinis frit*). There is no reason for supposing that these losses have been increasing owing to a greater prevalence of the pest in the northern counties, especially when one considers that damage done by Frit Fly has often been attributed to wireworm, eelworm, etc. As recently as last summer some fields of oats, reported as suffering from an attack of wireworm, were, on examination, found to be infested with Frit Fly.

A concise description of the insect, and a general account of its life-history have appeared already in the *Journal*,* and the subject of Frit Fly is dealt with in detail in the Ministry's Leaflet No. 202. but, for the benefit of north-country farmers, it may be well to give here an outline of the main features of its life-history, as relating, in general, to the northern counties.

Life History.—Although there may be a good deal of variation in the times of appearance of the broods, and even in their number, observations have shown generally that there are three main broods of flies in the year, and that the first brood appears on the wing in May, or, if the weather conditions have been particularly favourable, towards the latter half of April. The female flies of this brood, after mating, lay their eggs on or under the leaf-sheaths of the young (spring-sown) oat plants, the number of eggs laid by a single female being variously estimated at from twenty to seventy.†

* "The Frit Fly," R. Stewart MacDougall, D.Sc., *Journal*, Aug., 1907, Vol. XIV, p. 297.

† See "A Short Summary of our Knowledge of the Frit Fly," by J. E. Collins, F.E.S., Annals of Applied Biology, Vol. V, No. 2, October, 1918, p. 81.

The small, white legless larva or maggot, issuing from an egg, eats its way to the centre of the plant, upon which it feeds, with the result that the young central shoot turns yellow or yellowish-brown. This withered appearance of the central shoot, though the outer leaves may be healthy, may be taken generally as a sign of Frit Fly attack, and should be specially noted by the farmer. If the maggot is still present, it will be found readily in May and June, by carefully exposing the central shoot, and breaking open the rotting portion usually seen as a result of the attack. When full-fed the maggot changes to a pupa inside its larval skin, forming what is called a "puparium." These brown puparia usually remain within the sheathing leaves for some time after the fly has emerged, and so form a good indication as to the cause of the damage, when other signs are not apparent.

From these puparia the flies of the second brood emerge in July and the beginning of August, when eggs are laid on the ears, or on the sheaths enclosing the ears, and, after passing through the changes already described, the flies of the third brood appear in August and September. These flies now lay their eggs on grasses, and on autumn-sown oats, if the latter are available and at a suitable stage of growth. The maggots hatching from these eggs make their way to the young central shoots, but, unlike those of the previous broods, they remain as maggots throughout the winter, changing into pupæ in the following spring, thus giving rise to the first brood of flies referred to above as laying their eggs on the young spring-sown oats.

Observations in the Northern Counties.—In the course of a considerable number of advisory visits to farms in the north during the past season (1922), observations continued to be made on the general occurrence of Frit Fly. At one centre (Newton Rigg, Cumberland), an attempt was made to estimate the percentage of attack on twenty-seven varieties of oats at an early stage of growth, with the object of ascertaining any subsequent signs of recovery that might indicate special powers of resistance to attack in any of the varieties.

The earliest sign of appreciable damage was on 22nd April, when Frit Fly larvæ, completing their winter stage, and commonly associated with grasses as their habitat preparatory to the emergence of the first brood of flies of the year, were found at Cockle Park, amongst Great Mogul oats (sown Nov., 1921). These oats, though normally spring-sown, were used in this field

as winter oats, and were growing alongside a portion containing Winter Dun oats sown on the same date. These latter showed no signs of Frit attack, probably owing to the stronger growth to be expected from an oat normally winter-sown, as compared with Great Mogul. The larvæ examined varied much in size, and the emergence of the first brood of flies for the year must have been very irregular, a result which was perhaps encouraged by the backward and wet weather prevailing in February and March.

In spring-sown oats, the larvæ of the first brood of flies were feeding on young oat shoots by 10th June, on which date, at Cockle Park, Great Mogul, Victory, Black Bell, Yielder and Canadian Western were all affected. During the last week of June these larvæ of the first brood were pupating in oats in Northumberland and Durham, thus giving rise to flies of the second brood of the year, the larvæ from which were to be found in late tillers, and in the young ears, during July. A few puparia were found on 21st July, attached to exposed ears of Canadian Western oats at Cockle Park. The presence of these puparia, while maggots in various stages of development were numerous pointed to irregularity in the time of emergence in the case of the second brood of flies also. The earliest emergence amongst a few of the puparia kept in a cool room was on 6th August, but adults were not observed in the field in any numbers till the third week of that month, thus indicating the latter half of August as the main period of emergence of the third or autumn brood of flies.

"Blind" Ears in Oats.—In Cumberland arrangements had been made with Mr. Lindsay Robb, Principal of the Farm School, Newton Rigg, to begin an investigation to determine the comparative powers of resistance to Frit attack shown by different varieties of oats. A general survey of the extent of attack on twenty-seven varieties (sown on 5th April) was made on 29th June, in the course of which larvæ at different stages of growth were still plentiful, but, on that date, they were most numerous above the second and sometimes the third nodes, and in the unopened panicles. These latter, on being examined, revealed the so-called "blind" spikelets suggested as being caused by a brood of flies, intermediate between the dying off of the tillers, and the attack on the grains.*

The presence of these "blind" ears has been very prevalent in Frit-attacked oat fields, generally, in the north, and they

* "Frit Fly in Relation to Blindness in Oats," A. Roebuck, Annals of Applied Biology, Vol. VII, p. 178.

must have accounted for a considerable loss of grain in the aggregate of the crops. During the past season there was evidence of much overlapping of the broods, and it is quite possible that this overlapping may have reached the extent of forming an extra brood which would account for this form of damage.*

Early Sowing.—Inquiries made at farms, particularly in Northumberland and Durham, have generally confirmed the advantage of early sowing (on a good tilth) for avoiding Frit Fly attack. In most cases, oats sown in the beginning of March largely escaped damage, the individual plants having got well forward, with the result that only a few small side-shoots were attacked. On the other hand, oats sown in April or the beginning of May invariably cut thinly. This was confirmed at Cockle Park, where trials were commenced in 1920-21 to test the advantage of early, as compared with late sowing against Frit attacks. The trials were continued in 1921-22 and showed similar results.†

Mr. Robb informed the writer that it is a common belief in Cumberland that oats grown after turnips suffer more severely than when grown after ley. In Northumberland and Durham, the attacks appear to be equally serious, in so far as the writer has observed. Where, however, this condition occurs, it may be due to late sowing following the removal of a root crop.

Extra Seeding.—An interesting observation which appears to justify extra seeding as a precaution against loss of crop from Frit attacks was made in a field of Longhoughton oats in Co. Durham, in which the seed drill had gone round the sides of the field three times, and then across and back on the remaining inside portion. Where the extra seed had fallen in the process of turning, the oats stood out as two conspicuously good strips in the crop, which was otherwise thin, and badly attacked by Frit.

Preliminary Trials of Recovery from Frit attacks amongst varieties of Oats.—Reference has been made above to these trials which were carried out in Cumberland in conjunction with Mr. Robb. Twenty-seven varieties of oats, sown on 5th April, at a rate equivalent to a seeding of 3,000,000 grains per acre for each variety, and grown under the same conditions on conveniently wide lengths of a field at Newton Rigg, were

* See "The Frit Fly on Oats," T. H. Taylor, M.A., Bulletin No. 108 (Leeds University).

† See Guide to Experiments at Cockle Park, 1922, p. 32.

examined on 29th June, 1922. For each length of plot the approximate middle line was chosen, and the writer walked along this, stooping down after every two or three yards and examining the plants in about a foot length of the drill. At intervals a similar examination was made in drills at varying distances from the central line. In each a note was made of the percentage of damaged plants. At the same time Mr. Robb made a general survey of the plot, and at the end of each examination notes were compared.

More accurate results might have been obtained by digging up the plants from every foot-length examined and taking counts of these in the laboratory, but considering the length of the plots such a procedure would have involved enormous work for which time did not allow. As it was, the frequency with which Mr. Robb's estimates coincided very nearly with those of the writer was encouraging.

Although, obviously, one cannot deduce anything definite or of general application from observations made for only one year in one particular locality, yet the results are useful as affording a preliminary indication as to the likelihood that certain varieties of oats possess superior powers of recovery from initial attacks of Frit Fly.

For example, Crown and Ascot had an estimated extent of attack on 29th June of as much as 50 to 60 per cent. Later, however, both made an excellent recovery, so that judged by the yields of grain alone they came out best on the list. Even English Banner, the most severely attacked amongst the varieties in the early stages of growth, improved greatly in July and August and gave no mean yield of grain.

On the other hand Potato, Sandy and New White (1922), showing 50 to 60 per cent. of damage on 29th June, could not apparently "grow away" from this severe early attack, in so far as yield of grain is concerned. The proportion of yield of straw, however, in these three is relatively high, a fact which may be accounted for by the good tillering properties possessed at any rate by Potato and Sandy.

Golden Rain (30 to 40 per cent.) made a good recovery as compared with either Canadian Western or Sir Douglas Haig. Sir Douglas Haig, especially, a poor tillerer, went off at an early stage of growth, and though it showed signs of slowly recovering, its resistance against Frit attacks appears to be much inferior to that of Golden Rain.

With regard to the varieties with an initial extent of attack estimated at 40 to 50 per cent. all recovered well except Black Tartarian, and Mr. Robb reports that Yielder "did not make the rapid recovery that one might have expected from an oat of its good tillering properties, but it gradually improved and would undoubtedly have taken a higher place in the list, but for the fact that it was severely attacked by sparrows."

Conclusions from Observations and Trials.—(1) Observations during the past year have almost always shown the advantages of early sowing as a preventive. If the land can be got into good order for spring sowing of oats, these should be sown in March rather than in April.

(2) Autumn-sown oats are to be recommended in place of spring-sown in places where the latter have gone off yearly on account of Frit Fly. In some parts of county Durham winter oats are gradually replacing spring oats.

(3) Extra seeding of spring-sown oats has been observed to give good results, and is worthy of consideration.

(4) It seems likely that certain varieties of oats suit certain districts as regards their power of recovering from Frit Fly attacks. Farmers in the northern counties should note especially what varieties appear to escape damage, say, by observing crops on neighbouring farms that have escaped, seeing that the preliminary trials described above must be repeated and perhaps modified before definite advice can be offered on this point.

(5) Even these varieties may suffer to some extent in yield of grain from late attacks of Frit, but a relatively large yield of straw is likely to compensate much for such loss in grain.

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THE TRAP NESTING OF DUCKS.

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UNTIL quite recently the claims of the duck as a profitable producer of eggs were largely overlooked by the majority of poultry keepers. This is probably attributable to the fact that for profitable production from any large number of ducks, considerable land is desirable in order to provide the necessary conditions. Ducks appear to require natural exercise and natural food to a larger extent than fowls if they are to produce eggs at a profit,

and for this reason they seem to be far better suited for the conditions of the general farm than for the more intensive and artificial conditions under which fowls are now kept in such large numbers.

It is true that for many years the Indian Runner duck has been recognised as a heavy layer and that this breed has been kept by farmers, mainly in the North of England, for the purpose of egg production. The farmer, however, has usually been the last class of person to recognise the commercial value of any sort of poultry, and hence the progress made by the laying duck has been slow and its merits have been obscured by those of the laying hen.

Advent of the Trap Nest and of Laying Tests.—Had it not been for the introduction of trap nesting and of laying tests for ducks, with the consequent publication of records which can be generally accepted as coming from unbiassed sources, the attention now drawn to duck keeping for the production of eggs might have been long delayed.

One can recall many claims made by individual duck keepers as to the large numbers of eggs produced by their birds which when made did not receive the attention they merited, owing to lack of evidence such as that given by trap nest records. So far as is known no attempt was made to establish these claims until 1917, when a test of a semi-official character was arranged by Mrs. Upjohn, an enthusiastic duck keeper and member of the Utility Duck Club, which received the recognition of the National Utility Poultry Society.

Following this, duck breeders were fortunate in securing the interest of Mr. J. N. Leigh, manager of the National Utility Poultry Society's Laying Trials, and a duck section was included in the National Laying Tests held on the Great Eastern Railway Farm at Bentley in 1920-21. The provision made by Mr. Leigh for this test was most practical and complete. The results were extremely good and immediately attracted public attention. A marked improvement was shown in the results of the second test held under the same conditions and management in 1921-22, and the tests now proceeding promise further interesting results.

Trap Nesting.—As the duck almost invariably lays her eggs during the night or in the early hours of the morning, trap nesting is greatly simplified. In so far as labour is concerned the trap nesting of ducks is a far easier matter than that of

fowls and it is only necessary to make provision for the separation of the ducks at night time in order to keep the laying record of each individual. This can be done without the aid of the trap nest, but the addition of the automatic trap is a great convenience, as it saves labour and causes less disturbance to the ducks. Trap nests of the type used for fowls are suitable also for ducks. The wire release-catch, which the bird carries inwards upon entering the nest, with the drop door from above, is probably the most convenient trap for ducks, which will quickly become accustomed to it.

In the plan adopted at the laying test a separate small hutch, consisting of a nesting box in which the duck sleeps at night and an open run where the bird is fed, is provided for each duck. The trap is fixed at the entry to the run so that only one duck can enter a compartment. Two long rows of these hutches are placed on either side of a broad yard, into which the ducks are allowed at feeding time, and, passing down on either side, they enter the traps, are fed in the runs and remain until the following morning. A similar plan is followed for the sleeping and recording of their ducks by some breeders, but in a method adopted by others a house is used with compartments down either side for the ducks and a gangway down the centre for the use of the attendant. The gangway can also be utilised for the accommodation of other birds which are not being recorded.

The plan of a house of this type used by one noted breeder is illustrated in Fig. 1; this is 10 ft. long, 6 ft. wide, and 6 ft. 6 in. falling to 5 ft. in height, with a roof of lean-to type. There is a range of nine divisions (nests) on each side of the house, with a gangway between of 2 ft. 6 in. The divisions are of netting on wood frames, with light frames laid on top to prevent the ducks escaping and for removal for attendance when trap nesting. Shutters on the outside are used to cover the entrances to the nests at night time. The whole of the interior fittings are easily removable, so that the house can be used for a flock of young birds or an unrecorded flock of adults. This house is especially designed for a breeding flock and for recording the eggs; the accommodation is for 18 ducks, and the drakes which complete the flock sleep in the gangway. The dimensions are unusual for a duck house; it is, however, intended for a special purpose, and the height, which affords convenient room for the attendant, adds to the airiness of the house and the general well-being of the birds. The arrangement of the nests and

the ease with which they may be removed to facilitate cleaning are also points which have been carefully considered in the design of the interior fittings.

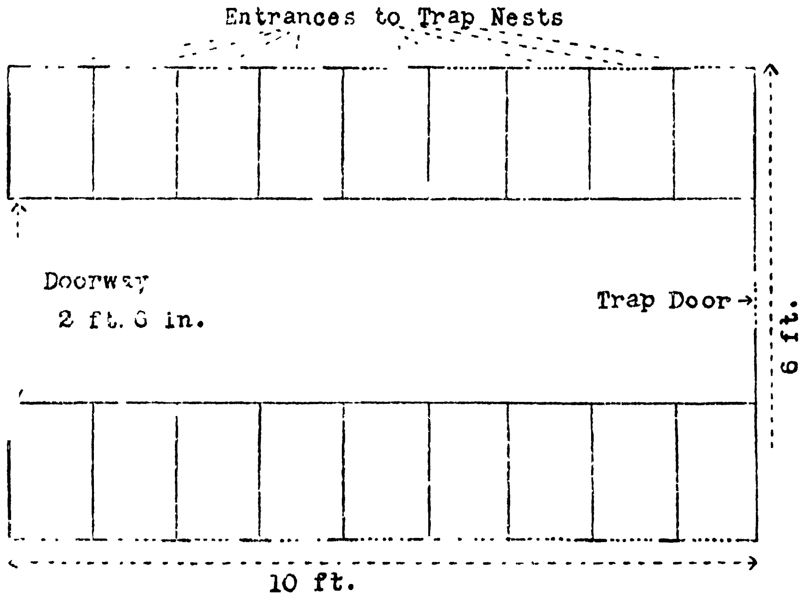

FIG. 1. Plan of Duck House designed for Recording with Trap Nests.

In trap nesting ducks, the birds are frequently fed inside their compartments, as at Bentley, and are trained to use the traps in this way in the first instance, but it is not necessary to continue the practice, since when accustomed to using the traps they are easily induced to enter at evening time without food. It is also curious to note in a flock which is mated for breeding, how the drakes separate and enter the door of the house to sleep in the gangway, after the ducks have disappeared into the traps.

Trap Nest Records.—Some very remarkable individual results have been obtained in the duck tests. One bird which laid 294 eggs in the 44 weeks covered by the Bentley Test in 1921-22 was retained for the completion of a year's record, in which time she laid 350 eggs. This bird was a fawn and white Indian Runner. Two other ducks of Khaki Campbell breed gave the high records of 323 and 303 eggs in 365 days, the former laying 201 eggs without a single break. These birds formed part of a pen of 5 ducks which laid an average

of 276 eggs per bird in the year, while another pen of this breed averaged 237 eggs per bird in the 308 days of the original test.

High records are not confined to any one breed of ducks, since individual ducks of the Buff Orpington, Coaley Fawn and White Runner breeds contributed records of 287, 246 and 248 eggs respectively in the 308 days' test. It is, however, interesting to note that Indian Runner blood has been utilised in the formation of the other breeds mentioned.

Breeding and Management.—How far the rapid improvement attained in production from the laying duck may be due to selective breeding or to experienced management it is impossible to say. It is interesting to learn that the record layer of 350 eggs in a year was the offspring of a duck which laid 205 eggs in the 9 months' test in 1917-18, mated to a drake bred from a layer of 320 eggs in twelve months sired by a 314-egg pedigree drake.

On the other hand, a study of the weekly returns of the Bentley flocks provides an interesting record of the progress which is being made in management.

In the 1920-21 test (48 weeks) 220 birds produced an average of 160 eggs per bird, while in the 1921-22 test (44 weeks, 265 birds) the average was 175 eggs per bird. This improvement is even more marked in the returns to date of the 1922-23 test. Moreover, the improvement in laying has taken place principally during the winter months, when eggs are most profitable. The credit for this improvement is largely due to, and serves to illustrate the value of, skilled management. The average poultry keeper, however, who is successful with fowls should have no difficulty in succeeding with laying ducks; but there are points of difference in management which require to be studied.

The timidity of ducks is not always sufficiently recognised; the birds are very easily upset by anything out of the ordinary, and need to be quietly handled. Instances are given where production has ceased owing to the trimming of a hedge round the duck pen, to fright caused by aeroplanes and to other unusual happenings. On the other hand ducks rapidly respond to gentle and regular treatment and become very tame. Regularity in feeding and attention is most important. Feeding is simple, as the ducks will find naturally a large proportion of their own food, and do not require much variety in food or

FIG. 2.—Range of Duck Pens, showing passage from which the Ducks enter the Trap Nests.

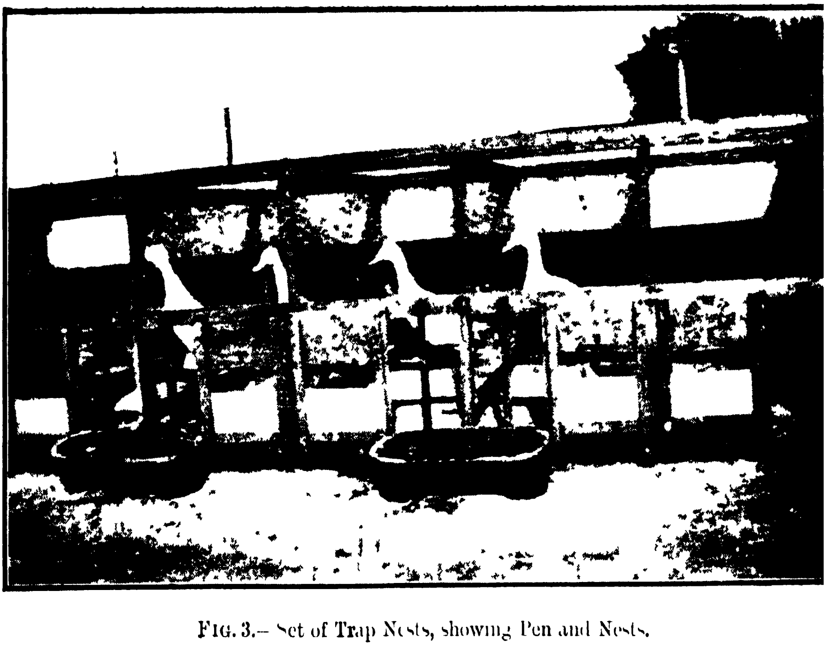

FIG. 3.—Set of Trap Nests, showing Pen and Nests.

any greater quantity than laying hens, provided they are given a good range.

While it is important to note that when housed at night, dry, clean bedding must be supplied to ducks, the experience of at least one well-known breeder is well worthy of mention. In this instance, houses are considered unnecessary, the ducks being allowed to sleep throughout the year in open pens, into which they are driven at night time for protection against ground enemies and for facilitating the collection of their eggs. Production under these conditions is most satisfactory, as evidenced in one case in which an average of 284 eggs was obtained from a flock of 7 ducks in 12 months. A considerable saving is effected in outlay and in labour without the provision of houses or the necessity for cleaning.

No doubt a great deal has yet to be learned in the breeding and management of ducks. The extension of duck keeping and the addition of sections for ducks at other laying tests is bound to throw fresh light upon the subject. Fruit growers may anticipate useful information as a result of the test in progress at the South-Eastern Agricultural College, where the ducks are running under fruit trees. The investigations with fowls already made at the College have served to prove the value of poultry keeping to fruit growers by drawing attention to the great quantity and variety of insect pests which are destroyed by poultry.

The writer is indebted both to the Secretary and to members of the Council of the Utility Duck Club for information and illustrations. It is a special aim of the Club to bring duck keeping to the notice of farmers and to assist them to secure reliable stock and information on the management of ducks.

Duck keeping has many points in its favour for the general farm, and as an alternative to fowls on some farms ducks are to be preferred. If it is to be successful, however, duck keeping —like other farm projects—requires to be carried out upon a well organised plan.

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CROPS AND PLANT BREEDING: RESEARCH METHODS IN NORTH AMERICA

II.

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Grassland and Sward Problems.—The famous Blue Grass pastures so prominent in Kentucky and other States are very different from the fattening pastures of this country. The sward is not nearly so dense and the productivity not so great, as it apparently takes about three acres to fatten a beast on even the best of these pastures. It is interesting to find that erroneous ideas on stocking are current in regard to these pastures just as in relation to our grasslands. Thus Lymen Carrier and R. A. Oakley* have shown that relatively heavy grazing gives better results than light grazing and has an altogether better influence on the quality of the sward.† Since these swards are not dense it is not surprising to find that dragging with a heavily tined implement has not the ameliorating influence on the Blue Grass pastures that it so commonly has on our dense and matted swards.

Derelict grassland is a great problem in America, for cropped out land when let out of cultivation does not so rapidly produce a tolerable sward as in this country, and the vegetation of these pastures is heterogenous to a degree, although eventually blue grass may establish itself satisfactorily while the indigenous range grasses (*e.g.*, *Andropogon*, spp.) are exceedingly poor recolonizers.

It is worthy of comment that white clover is usually fairly abundant in good blue grass pastures, and in certain years becomes almost a dominant plant, while it may be encouraged by dressings of ground lime on derelict areas to a wonderful extent. The readiness with which white clover responds to lime (even comparatively small dressings) is probably largely due to the earthy rather than dense nature of these swards. It is somewhat remarkable that blue grass has become so particularly

* See Lymen Carrier and Oakley, R. A., "The Management of Blue-Grass Pastures," Bull. 204, Virginia Agr. Expt. Station.

† Cook (Bull. 177, Agric. Expt. Stat. of West Virginia) points out, however, that the grazing should not be heavy until growth has fairly started, and heavy grazing should not be continued into the autumn.

aggressive and that it has not been accompanied by several other species of European grasses, such as crested dogstail. The paucity of the flora on the best blue grass pastures was very striking. Ribgrass was fairly common and sometimes red top; Crested dogstail was not once seen, and it is stated to be a rarity in the United States despite the fact that thousands of pounds of seed are sown annually. Indeed it is evident that the American farmer is often as prodigal in sowing species in his mixtures which are foredoomed to failure as is his British cousin. The type of mixture recommended to establish a blue grass pasture is usually as follows: 10-12 lb. blue grass, 4-5 lb. Timothy, 2-3 lb. white clover, sometimes with the addition of 2-3 lb. Japan clover, to which 2 lb. of all or any of the following are sometimes added: Red top, orchard grass (cocksfoot), red and alsike clovers. Meadow foxtail has also been tried with promising results.

Cocksfoot (= American orchard grass) when sown in large amount is now to some extent finding favour as a pasture-forming grass.

Opportunity was afforded of inspecting some of the range grasslands of Kansas and seeing the interesting investigations being conducted by Professor R. L. Hensel of the Experimental Station, Manhattan. One of the chief problems of these grasslands, which are natural types of vegetation, is to maintain a good gramineous sward—the position is here very different from that of the blue grass pastures and of our own dense-swarded grasslands, and deterioration tends to follow from heavy grazing, the chief reason apparently being that it is necessary to allow the grasses to re-seed. Unfortunately the *Andropogons* of the ranges are very poor seeders. Herefords are chiefly used on those ranges, being fattened on the pastures with the addition of cake.*

Fundamental Research.—Federal funds allocated to agricultural research are not by any means only confined to the solution of problems such as the average practical man would deem to be of obvious economic importance; this fact is well exemplified by the character of many of the investigations in progress, and by none more so than by the work of Drs. Garner and Allard on the effect of the length of day on the flowering and fruiting of plants. These important investigations are being conducted at Arlington Farm, and have already proved to be of profound

* More detailed particulars of Professor Hensel's work are not given as he has not yet published a full report.

economic significance. It is obviously a matter of importance to the farmer to know that the time at which his crops come into flower is under ordinary field conditions affected to a considerable degree by the length of the day, and that different crops and different varieties of the same crop make very different demands on this ever operative factor of the environment. The reader is referred to the authors' papers for details of the investigations* but reference may be made to at least one tangible benefit to the American farmer as a direct result of the work. In Maryland is grown a mammoth tobacco which develops to an unusual size; it, however, does not flower in the field in that locality—or it flowers too late for the seed to mature properly. In the greenhouse this tobacco flowers freely under the ordinary day length of winter. The reason for it not flowering in Maryland is because the summer days are there too long. The problem of producing seed of this variety has therefore been solved by growing the plants specially for this purpose during the winter in the south of Florida.

Plant Breeding.—The importance of disease-resistance as it affects yield and quality is fully appreciated by the American plant breeder. It is probable that disease accounts for a greater average reduction of crop per unit of area in the States than in this country, and this not so much on account of any greater virulence of the disease organisms as on account of the much larger contiguous areas under one and the same crop, which would seem considerably to facilitate infection. Breeding for disease-resistance consequently takes a prominent place wherever plant breeding is in progress. This is work particularly amenable to co-operative attack and to a thoroughly well organised system of recording and tabulating results, and is again work that is only possible by resort to numerous small scale trials conducted over the widest possible area. Thus we find Dr. C. E. Leighty of the Bureau of Plant Industry co-operating with Dr. Mains in the prosecution of researches conducted at seven different stations relative to strains of wheat resistant to Leaf Rust (= Brown Rust, *Puccinia triticina*). At many of the Stations elaborate researches are in progress with a view to breeding strains of cereals resistant to both insect and fungus attack.

* See Garner, W. W., and Allard, H. A., "Flowering and Fruiting Plants as Controlled by the Length of Day." Separate No. 852: Year Book U.S. Dept. Agr., 1920; and "Effect of the Relative Length of Day and Night and Other Factors of Environment on Growth and Reproduction of Plants," in Journal Agr. Research, Vol. XVIII, No. 11, March, 1920, also "Photoperiodism, the Response of the Plant to relative Length of Day and Night." Science, n. ser. LV (1922) No. 1431, 2nd June, 1922.

The work conducted by Drs. L. E. Melchers and J. H. Parker at Manhattan, Kansas,* affords an excellent example alike of the progress being made in this direction and of the well conceived field, greenhouse and laboratory technique that has been developed in order adequately to carry out these researches.

Four important points, all of which have their bearing on methods adopted in this country, emerge from discussion with the men actively engaged on this important branch of research: (1) The necessity of intimate co-operation between a plant breeder and a mycologist. (2) The local nature of the problems involved—speaking broadly it does not follow that a strain resistant to a disease (especially in the case of rusts but not necessarily only rusts) in one locality will be equally resistant in another. Thus, in its disease relationship, plant breeding is essentially a local matter. This is strikingly so in a huge country, but evidence is not lacking to suggest that in disease and other aspects plant breeding may advantageously be further localized even within the confines of Great Britain; or in any event that strains and segregates should be tested over widely different habitats. (3) Even in the case of diseases which are preventable by the adoption of remedial measures (*e.g.*, bunt and smuts of cereals) it is more economical to grow resistant strains than to rely on measures that will never be everywhere put into practice. The evidence which is rapidly accumulating appears to indicate that, given time and facilities, it should be possible to produce strains highly resistant to all the diseases which take such a heavy annual toll from the crops of the world. (4) The necessity of having not only a means of distributing rapidly new strains as they are produced, but also the means of withdrawing from cultivation the older strains which the newer strains *should replace*. This is an important and exceedingly difficult matter, for as plant breeding advances the improved strains are likely in appearance to be practically indistinguishable from the old. This is especially likely to be the case in regard to disease-resistant strains. In America the problem is likely to be solved by the Crop Improvement Societies, which have the great advantage of being local bodies ably supervised by the State Experiment Stations.

Good examples of disease-resistant strains already replacing older varieties are the Kanred wheat of Kansas, and Red Clover

* See Melchers, L. E., and Parkers, J. H., "Rust Resistance in Winter Wheat Varieties": U.S. Dept. of Agric., Bull. No. 1046, 1922.

resistant to Anthracnose disease selected by Professor Essary of Knoxville, Tennessee.*

The great majority of improved strains now largely grown in the States have been bred by selection and pure lines, but one has only to see the various segregates now on trial at Cornell and elsewhere to realize that the researches of Dr. Love and others who are working on Mendelian lines are very shortly destined to exert a profound influence on crop yields of cereals throughout the States.

Similarly with forage and herbage plants, technique and methods are rapidly being developed which will place the breeding of those crops on an exact and scientific basis.

Timothy and alfalfa breeding is in process at many of the Stations both in the United States and in Canada, while at Macdonald College and elsewhere in Canada exact hybridization work under controlled conditions is being undertaken with alfalfa, red clover and other herbage plants. At Cornell and at Macdonald College vegetative reproduction is largely used as an aid to the breeding of perennial grasses. Thus Dr. Myers at Cornell isolates his plants of Timothy for pollinating purposes by building up large beds of his strains by vegetative means, and at flowering time separating the beds by canvas sides and backs. The canvases are supported from horizontal wires attached to stout supports and are about 6 ft. high.† .

An ability to withstand the winter is very important in herbage plants for Canada and the Northern States: very striking results were seen at Macdonald College showing marked difference in winter hardiness as between different strains of Timothy and cocksfoot.

The distribution of improved herbage seeds and the maintenance of the purity of the strains is particularly difficult in the case of these plants, which so readily cross-fertilize.

In the case of Timothy the price obtainable for hay has tended to cause the growers of improved strains to sacrifice the seed crop for the more easily handled and marketed hay crop which has operated against the rapid replacement of inferior by improved strains, a difficulty which by proper organization will doubtless be overcome.

* Bain, S. M., and Essary, S. H., "Selection for Disease-Resistant Clover," Bull. No. 75, Agric. Expt. Station, Knoxville, Tennessee.

† This review of the work on herbage plants is very incomplete as unfortunately it was found impossible to visit either the Timothy Breeding Station of the Bureau of Plant Industry at Elyria or the North Dakota Station at Fargo as had been arranged.

The importance of purity of strain is fully realized in Canada, where exceptional facilities are afforded for growing improved strains of cross-fertilizing plants on farms miles from other farms growing the same species. Conversations with Canadian agriculturists suggest that it is likely that Alberta for instance has a great future for producing seed of pure strains. This fact, together with the well organized activities of the Canadian Seed Growers Association, is of great potential importance to American and European farmers alike. Canadian red clover seed, for example, is known to be of considerable value in Britain, but is often supplied by vendors in this country mixed as to strain or in blend with other red clovers.

The writer wishes to express his indebtedness to Dr. William A. Taylor, Chief of the Bureau of Plant Industry, to Drs. Carleton R. Ball and C. V. Piper, in charge of Cereal and Forage Crop Investigations at the Bureau, and to Drs. A. J. Pieters and Clyde W. Warburton respectively, of the Forage and Cereal Branches, for the trouble they took in arranging an itinerary of the Stations and for the help generously afforded in supplying information in respect of the organization and working of the Bureaux and Stations.

Thanks are also due to the investigators at the Stations and at the Bureau, too numerous to mention individually, who one and all were at such pains to be helpful, while the writer is equally indebted to Mr. G. H. Clark, Seed Commissioner, Ottawa, for his help and kindness during the period spent in Canada.

METHODS OF COVERING GRASS AND CLOVER SEEDS.

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THE results of the investigations in the depth of sowing grass and clover seeds previously given in this *Journal** obviously only apply to the conditions under which the investigations were conducted, namely, under exact laboratory and garden conditions, where tilth, moisture and temperature were under control.

In order to supplement these general results with information of more practical value another series of investigations was

* April, 1922, and May, 1922.

undertaken in order to determine the best methods of covering certain grass and clover seeds under ordinary field conditions.

Only the farm implements which are commonly used for the purpose were experimented with; the grass and clover drill which has recently been introduced has not been tried, but the method of sowing in drills is receiving attention and the results will be published in due course.

The investigations consist of three separate experiments, two of which were carried out on the experimental grounds of the Plant Breeding Station, while the other was conducted at Blaentwrch, Carmarthenshire.

Experiment 1.—Sixty-four rod plots were sown on 17th to 20th of May, 1920, on Penglais Field (medium loam in good tilth) during unsettled weather which proved highly favourable to germination.

An attempt was made to regulate the depth to which the seeds were buried by covering with different hand implements, namely, with an iron hand rake, a Canadian scuffler, and beating the soil with a shovel. Sixteen plots were done by each method, while the remaining 16 plots were left uncovered.

The plots were sown at four different rates, namely, full. $\frac{3}{4}$, $\frac{1}{2}$ and $\frac{1}{4}$ seedings, with a simple mixture consisting of 1 oz. of Italian rye grass, $\frac{1}{2}$ oz. cocksfoot and $\frac{1}{2}$ oz. red clover per plot as a full seeding. Half the number of plots were sown under rape at the rate of 2 lb. per acre, while the other plots were sown without a nurse crop. The whole block was so arranged that each of the four methods of covering had the same number of plots that had been treated differently as regards seeding.

All the plots covered by means of the rake, hand-scuffler and shovel were rolled a few days after sowing, but none of the plots were rolled before sowing.

Depths to which the Seeds were Covered.—An approximate estimate of the depths to which the seeds were covered by the different implements was made during the covering operations.

Rake.—About one-third of the grass seeds were left on the surface and hardly any of these seeds were covered to a depth of more than $\frac{1}{4}$ in., the average depth being about $\frac{1}{8}$ in. The clover seeds were more completely covered, the average depth being from $\frac{1}{4}$ to $\frac{3}{8}$ in., while a few were left uncovered.

Hand Scuffler.—Covered both the grass and clover seed more thoroughly than the rake, the average depth being $\frac{1}{2}$ to $\frac{3}{4}$ in.

Shovel.—Well over 50 per cent. of the grass seeds were covered to an average depth of $\frac{1}{8}$ in., while nearly all the clover

seeds were buried to a depth of about ¼ in. This method was much more effective in covering the seeds than the ordinary roller.

Surface Sowings.—A few seeds were covered as a result of treading during sowing.

The Number of Established Plants.—The number of plants of the three species sown were counted separately during the last week in July by taking 20 readings per plot, systematically distributed, with a 6-in. mesh. Counts were made on eight plots of each method of covering; the average results of these counts are given in Table I.

TABLE I.—Average number of plants of Italian Rye Grass, Cocksfoot, and Red Clover per 5 sq. ft. on plots covered by different methods.

Method of covering.	*Italian Rye Grass.*	*Cocksfoot*	*Red Clover.*
Not covered ...	86 ...	76 ...	31
Shovel	105 ...	89 ...	89
Hand Rake ...	100 ...	74 ...	65
Hand Scuffler ...	103 ...	77 ...	89

Italian Rye Grass.—As shown in Table I, the three methods of covering gave fairly similar results in spite of the fact that there was an appreciable difference in the number of seeds covered and in the depths at which the seeds were buried by the three implements, but the "not-covered" plots had from 14 to 18 per cent. fewer rye grass plants than the covered plots.

Cocksfoot.—Very similar takes were obtained from the "not covered" plots and the plots covered by rake and hand scuffler but the plots covered by means of a shovel and then rolled gave from 16 to 20 per cent. more plants than the other three methods.

These results seem to suggest that if the seeds are not covered, cocksfoot is able to establish itself more readily than Italian rye grass.

Red Clover.—Red clover was much more affected by the method of covering than the two grasses. The best results were obtained on the plots covered by shovel and hand scuffler. If the number of plants obtained on these plots be taken as 100, then the plots covered by hand rake gave 73, while the "not-covered" plots only gave about 35 red clover plants. That the depth at which the seeds were buried was not the main factor affecting the "take" of red clover in this experiment is clearly shown by the fact that the shovel and the hand scuffler, which covered the seeds to depths of about ⅛ in. and

½ to ¾ in. respectively, gave better results than the rake, which buried the seeds to a depth of about ¼ to ⅜ in. Since the "not covered" plots and the plots covered by rake, which had the greatest number of seeds exposed on the surface, gave the poorest results, it is evident that the "take" was mainly dependent on the degree of completeness with which the seeds had been covered.

Experiment 2.—This trial was conducted at Blaentwrch, Carmarthenshire, in 1920, on stiff clayey loam under barley. The soil was repeatedly harrowed and rolled after sowing the barley and was finally rolled before sowing the grass and clover seeds, but owing to the clayey nature of the soil, the tilth was rather poor, as the surface soil consisted in the main of small hard lumps ranging from ¼ to 1 in. diameter.

The following grasses and clovers were sown on the 15th of May on pure duplicated rod plots, at the following rates of seeding per acre:—perennial rye grass, 30 lb.; cocksfoot, 20 lb.; red clover, 20 lb.; and white clover, 10 lb.

Two plots of each species were covered by five different methods by means of various farm implements. These were:—

1. Roller.
2. Chain harrow followed by roller.
3. Chain harrow with spikes down followed by roller.
4. Light peg harrow followed by roller.
5. Plots not rolled before sowing or covered after sowing.

The Effect of the Different Methods of Covering on the "Take."—The number of plants was counted in October, 1920, by taking 10 representative readings per plot by means of a 6-in. mesh. The average results for the different methods, which are expressed in terms of the number of established plants per square foot, are shown in Table II:—

TABLE II.—Average number of plants per square foot with the different methods of covering.

Method of Covering.	*Perennial Rye Grass.*	*Cocksfoot.*	*Red Clover.*	*White. Clover.*
Not covered	62	68	36	7
Rolled once	58	75	41	16
Chain harrowed, spikes down and rolled ...	62	86	45	38
Chain harrowed and rolled	64	87	59	50
Peg harrowed and rolled	78	90	53	47

As will be seen from Table II, the "not covered" plots and the plots covered by rolling only, while giving moderately good "takes" of perennial rye grass and cocksfoot, gave very poor results for both clovers—particularly for white clover. Despite the fact that a comparatively large number of seeds found

their way down between the small lumps which formed the surface soil, it is evident that neither red nor white clover was sufficiently well covered on these plots. The method of covering with spikes down was a decided improvement on rolling alone, the improvement in "take" being most marked in the case of white clover.

The two implements which gave the best results were the chain harrow and the peg harrow. The chain harrow produced a slightly better "take" of clovers than the peg harrow, but on the other hand, the rye grass plots had 22 per cent. and the cocksfoot plots 3.5 per cent. more plants when covered by the peg harrow. The total number of plants of the four species was practically the same for both methods; the difference in favour of the peg harrow is consequently regarded as being too small to be of any significance.

Experiment 3.—This was carried out on the Station's experimental grounds in 1922. Although the experiment was entirely confined to red clover it was of a much more exhaustive nature than the two experiments already described.

The block on which it was conducted had carried an oat crop in 1921. The ground was ploughed twice during the autumn, and again in March, and subsequently harrowed to a very fine friable tilth. The soil was a light loam of rather a stony nature. Forty 1/100th-acre plots were sown on the 8th May with two strains of red clover:—English broad red and Montgomery red, on duplicated plots, at the uniform rate of three million viable seeds per acre which was equivalent to 17.8 lb. per acre of broad red (90 per cent. germination) and 12.3 lb. of Montgomery red (96 per cent. germination). They were covered by the ten methods tabulated below, and arranged in such a way that four plots consisting of the duplicates of the two strains were covered by each method.

The implements used for the different methods of covering were:—

	For final operation before sowing.	*For covering after sowing.*
1.	Chain harrow ...	... None ("not covered").
2.	Smooth roller ...	... Smooth roller.
3.	Chain harrow ...	... " "
4.	" " ...	... Horse hay rake followed by smooth roller.
5.	" " ...	... Cambridge roller " " "
6.	Cambridge roller	... " " " " "
7.	Smooth roller ...	... Chain harrow " " "
8.	" " ...	.. Light peg harrow " " "
9.	Chain harrow ...	... Chain harrow " " "
10.	" " ...	... Light peg harrow " " "

The soil was in an excellent condition for sowing. The fairly heavy rains of the last week of April and the first four days of May had ensured that it contained an abundant supply of moisture for germination while the surface soil was dry and friable. With the exception of a short break of intermittent rain 8 days after sowing the weather was warm and dry from the 5th to the end of May.

The counts were made on the 30th and 31st of May in the usual manner by taking 20 representative readings per plot with a 6-in. mesh. The average results of the counts are summarized in Table III.

The number of dead seeds found on the surface were counted by the same method. These figures, which are also shown in Table III, are admittedly only approximately correct on account of the difficulty experienced in detecting the "surface" seeds which were very much discoloured. Most of these dead surface seeds had obviously germinated, but had died back after failing to take root.

TABLE III.—Showing the average number of Red Clover seedlings and dead surface seeds per square foot on plots covered by different methods.

Method.	*Number per square foot.* Seedlings.	*Probable Error.*	*Dead surface seeds.*
1.	15·9	± 1·73	8·0
2.	17·7	± 1·20	12·8
3.	28·0	± 2·07	7·0
4.	37·9	± 2·79	2·6
5.	40·2	± 3·31	3·8
6.	40·2	± 3·35	6·1
7.	45·7	± 2·19	3·2
8.	49·6	± 2·04	2·4
9.	45·1	± 3·14	1·6
10.	44·5	± 1·42	2·0

Loss and Waste of Seed.—It is not generally realised that the usual method of sowing small seeds broadcast is exceedingly wasteful, and that a large amount of seed is lost even when the most efficient method of covering is employed. For instance, only 44 to 49 seedlings per square foot were counted on the plots covered by peg and chain harrows, although the plots had been sown at the rate of 69 viable seeds per square foot, that is, 28 to 36 per cent. of the germinable seeds sown failed to become established. In other words, as much as 4½ lb. to 6½ lb. per acre of pure viable seeds of the broad red clover, sown at the rate of 15.8 lb. per acre, were lost. With the seed of broad red clover at 2s. per lb. this entails a cash loss of 9s. to 13s. per acre.

The Chief Cause of Failures in "Take."—A glance at Table III will show that there is a very definite correlation between the number of established seedlings and the number of dead seeds found on plots covered by different methods, and that on the average the best results were given by methods which left the fewest seeds uncovered. This was fully borne out by observations made on the plots during the covering operations. It is thus evident that the "take" was not seriously affected by the depth to which the seeds were covered (within the range of depth effected by the various methods employed); it seems to depend almost entirely on the degree of thoroughness with which the seeds were covered.

The failure of uncovered red clover seeds to become established is due to the inability of the radicles to enter the soil in the absence of a thin covering of soil which holds the seeds in position until the radicles are fixed.*

Soil and Weather Conditions affecting Covering.—*Soil.*—While making the counts on No. 3 experiment it was observed that the seedlings were almost invariably thicker on the portions of the plots where the surface soil consisted mainly of small lumps ranging from ¼ to ¾ in. in diameter, than on areas on which the surface soil had been reduced to a very fine state of tilth.

The superior "take" obtained on the fairly coarse soil as compared with that found on very fine soil is easily explained by the fact that the small loosely packed lumps of the coarse soil offered less resistance to seed penetration than the close packed minute particles of the finer soil. The seeds were therefore much more thoroughly covered on the coarser areas.

Weather.—With a view to determining the effect of the weather conditions prevailing at the time of sowing on the resultant "take" of red clover, counts were made on a number of plots of two red clover nationality trials laid down at the Plant Breeding Station in 1922. The results obtained are compared with those given by the plots which had been similarly covered in No. 3 experiment.

The No. 3 experiment and the two trials referred to were all sown on light loam but in different fields. All the plots were sown at the same rate, namely, three million viable seeds per acre, and were similarly covered by means of a horse rake and rolled. The tilth of the three trial blocks was excellent. As previously stated, No. 3 experiment was sown on the 8th May,

* See Depth of Sowing: this *Journal*, April, 1922.

when the surface soil was perfectly dry, consequently the seeds on the raked plots were fairly well covered.

One of the nationality trials (Trial A), which consisted of 84 one-hundredth-acre plots, was sown on 23rd May, under what was regarded at the time as ideal weather conditions for sowing small seeds, namely, during a spell of showery weather and when the surface soil was decidedly damp. The seeds were very poorly covered as they clung to the wet surface soil instead of dropping through between the particles as they do normally when the soil is dry. It rained fairly heavily on the night 23rd/24th May but on 25th the weather changed to a dry period which lasted over three weeks. The seeds germinated exceedingly well within 3 to 5 days of sowing, but it was observed that practically all the surface seeds failed to take root. As a result all the plots gave very poor "takes," although the ground which had not been ploughed since December, 1921, contained an abundant supply of water which proved quite sufficient to maintain the seedlings that had taken root in a healthy growing condition throughout the period of the drought.

The other Trial (B), which involved 168 one-hundredth-acre plots, was sown on the 29th May under totally different conditions from Trial (A). The ground was ploughed twice, as late as April and May, and was so thoroughly worked during the dry weather of May that the top 3 to 4 in. of soil was practically dry when sown. The seeds were therefore exceedingly well covered.

Sowing took place during a long drought which, to all intents and purposes, lasted for 24 days after the sowing, although a little rain was recorded 16 days after sowing. The seeds remained in the ground for nearly four weeks without showing any signs of germinating, but they soon germinated after the heavy showers of 22nd and 23rd June and gave surprisingly thick and uniform "takes" on all the plots.

Four plots sown with the same lots of English broad red and Montgomery red clovers were counted in the usual way by taking 20 readings per plot in each of the three trials.

The average results are given below :—

Trial.	*Condition of soil at time of sowing.*	*Date of sowing.*	*No. of seedling per sq. foot.*
No. 3 Experiment ...	Surface soil—dry ...	7th May ...	$37 \cdot 9 \pm 2 \cdot 79$
A	... Surface soil—decidedly damp	23rd May ...	$23 \cdot 8 \pm 0 \cdot 10$
B	... Surface soil—particularly dry	29th May ...	$43 \cdot 0 \pm 1 \cdot 26$

These results show that the raked plots of No. 3 experiments and the Trial B plots gave respectively 57.9 per cent. and 80.7 per cent. more seedlings than the counted plots of Trial A. These results fully confirm the observations made on the relative "takes" obtained in the different trials.

It is thus evident that satisfactory "takes" cannot be obtained if the seeds are sown broadcast when the surface soil is wet, and that excellent results will be obtained if the seeds are sown during a long period of drought provided (1) the soil is sufficiently dry to delay germination until the drought breaks, and (2) that the seeds are properly covered at the time of sowing.

SUMMARY.—The evidence discussed in this paper is summarized below. It should be emphasised, however, that the conclusions reached apply only to the species tested, namely, Italian rye grass, perennial rye grass, cocksfoot, red clover and white clover, and do not necessarily apply to other varieties of grasses and clovers.

1. Not one of the implements under investigation for covering grass and clover seeds buried the seeds too deeply. Hardly any of the seeds were covered to a depth of more than ½ in., even by the peg-harrow.

2. Good "takes" of red clover and white clover, and to a less extent of Italian rye grass, perennial rye grass and cocksfoot, depended more on the degree of thoroughness with which the seeds were covered than on any other factor usually operative when sowing small seeds.

3. The implements which gave the best covering invariably gave the best results.

4. The most effective implements for covering the grass and clover seeds investigated, on all the types of soils experimented upon, were the peg-harrow and chain-harrow.

5. The "not-covered" sowing and plots covered by a smooth roller gave fairly good results for the grass seeds, but very poor "takes" for clover seeds.

6. The horse-hay-rake and the Cambridge roller were not so effective in covering red clover seeds as the two kinds of harrows, except, possibly, under certain conditions, but they are superior to the harrows for covering trial plots. The chain-harrow, however, is a particularly unsuitable implement for this purpose as it is very apt to drag seeds from plot to plot.

7. A very fine powdery surface gave a poorer "take" than a slightly rough surface which consisted of small lumps ranging from $\frac{1}{4}$ to $\frac{3}{4}$ in. in diameter.

8. Poor "takes" of red clover were obtained from plots sown when the surface soil was wet, on account of the fact that the seeds which clung to the wet soil could not be properly covered.

9. Excellent results were obtained by sowing red clover on a very dry soil during a long period of drought which delayed germination for nearly a month.

10. There was an enormous loss of viable red clover seeds amounting to about 4 to 7 lb. per acre, even when the seeds were covered by the most effective implements.

11. It would seem from the results obtained that it is of the utmost importance to cover the seed properly; consequently, it would appear reasonably certain that very considerable economy could be effected, at all events in the use of the grass and clover seeds under review, if they could be sown with a special drill made for that particular purpose.

Grateful acknowledgment is made to Messrs. Sutton & Sons, of Reading, who kindly supplied the seed ready weighed and mixed for the numerous plots in connection with Experiment No. 1. Thanks are also due to Mr. A. D. Thomas, B.Sc, now Agricultural Organiser for Carmarthenshire, who assisted with the analysis made relative to Experiment No. 1.

* * * * * *

TRIALS OF POTATOES FOR IMMUNITY FROM WART DISEASE, 1922.

THE trials which are conducted by the Ministry each year with the object of testing new varieties of potatoes for immunity from wart disease were again carried out during 1922 on the farm of the National Institute of Agricultural Botany at Ormskirk. The actual field operations, and the taking of records, were carried out by Mr. H. Bryan, B.Sc., and Miss Whitehead of the Institute, but the trials were conducted on a plan approved by the Ministry.

The Ministry has accepted the findings of the Potato Synonym Committee set up by the Institute, and has classed varieties as synonymous with existing varieties where recommendations to that effect were made by the Synonym Committee.

After full consideration of the results of the trials, the following varieties have been added to the list of those approved as immune from wart disease:—

Millar's Beauty	Utility
Marquis of Bute	Golden Las
Ben Lomond	International Kidney
Ben Ledi	Clifden Seedling
Ben Cruachan	

In the report on the 1921 trials (see this *Journal*, March, 1922, p. 1147), it was stated that, except in one or two instances, the Ministry was unable to approve as immune from wart disease certain varieties which had successfully passed their second year's test, on the ground that because of the abnormal weather conditions, no dependable interpretation of the results could be made. Because of this decision it was necessary to grow at Ormskirk some 17 kinds for a third year's test. One of these 17 varieties—Ben Wyvis—succumbed to wart disease, but the others remained immune. This extra year's test, while it may have caused inconvenience to potato breeders, has, nevertheless, been the means of preventing an error and of maintaining the high reputation for accuracy which the Ormskirk trials must aim at.

Two of the varieties (Ben Nevis and Ben More) proved to be synonymous with existing kinds; one stock was badly mixed (Ben Doarg); in the case of three lots the growth was so poor that the Ministry cannot take them into consideration; and four are unnamed seedlings which may be listed as soon as the raisers have given them names. The remaining six varieties have been approved as immune varieties, and are included in the list above.

Ninety-one lots of potatoes on which no wart disease had appeared during the season of 1921 were included in the second year's trials, and, for the reasons stated above, it is not surprising to learn that in no fewer than 24 cases wart disease appeared amongst the crops in 1922. The freedom from wart disease of four others, Titan, Belle de Fontenay, Ben Braggle, and Ursus, is doubtful. Two lots were different from the variety tested under the same name in the previous year and were discarded. Eleven of the others proved to be synonymous with existing varieties in commerce, viz., Ben Avon, Ben Ratha, 8 historical varieties and one seedling, whilst one seedling was entered under two different numbers. In four instances (Quarantaine de la Halle, Colonist and two seedlings) the growth of the crop was unsatisfactory, and although no wart disease appeared no decision as to immunity could be made. In the remaining 45 cases the varieties were distinct and free from disease. These comprised twelve seedlings (No. 1. BL., No. 12, No. 17. 461/16, No. 301, No. 310x, No. 365, Seeding C.1. and four others), and the following varieties:—Utility, Wild Rose, Macduff Seedling, The Massie, Glenalmond,

Merville D'Amerique, Ceres, Benalt, Ben Alton, Ben Hope, Ben Doirean, Ben Tee, Ben M'hor, Ben Staroa, Ben Vane, Ben Fin, Ben Tallach, Ben Bhan, Ben Alder, Ben Choire, Ben Fhada, Ben Mere, Ben Hutick, Ben Cleuch, Ben Ime, Ben Scriel, Ben Eay, Destiny, Snowflakes, Brown Rocks, Red Kemps, Brown Blacks, Peps.

The rainfall during the early months of the test was below the average, the deficiency being 0·26 in. in April, 0·43 in. in May, and 0·13 in. in June, but above the average by 1·85 in. for the month of July, and 2 47 in. for August, so that the soil moisture was sufficient to allow the fungus full development. The temperature, however, was low, and the activity of the fungus was thus apparently hindered, for the losses of crop were less severe than was expected. Nevertheless, the test for immunity was a severe one, though not sufficiently rigorous completely to counterbalance the lack of dependence which can be placed on the tests to which the potatoes were submitted during 1921. It has, therefore, been decided that varieties in the last-mentioned group should not be approved as immune unless there are special reasons for such a decision. For most of these varieties there are no special reasons, and they will need to be re-tested in 1923. There is, however, sufficient evidence of the immunity of "Utility," and this variety has been approved.

Moreover, the variety previously known as Seedling 449 (a) (1), declared in 1920 to be immune, has now been put on the market under the name "Golden Las." It was again tested at Ormskirk, last year, and found to be free from wart disease, and has, therefore, been added to the approved list, together with the well known International Kidney and Clifden Seedling.

One hundred and thirty-four plots of potatoes were planted in the trials with varieties which had not hitherto been tested; of these 40 proved synonymous with existing kinds, and 40 proved susceptible.

Trials of seedlings, which are also made, are quite separate from the immunity tests proper. From 5 to 10 tubers only are planted, and the trials are carried out merely for the purpose of providing raisers with facilities for finding out quickly which of the seedlings are susceptible. Firms and private persons took advantage of this facility, together with the John Innes Research Station; the School of Agriculture, Cambridge; the Irish Department of Agriculture, and the Education Department, Lancashire County Council.

New Approved Immune Varieties.—The following are the descriptions of those varieties of potatoes which have been added to the Ministry's list of varieties approved as immune to Wart Disease in consequence of the 1922 trials. Descriptive lists of the varieties approved in previous years are obtainable free and post free on application to the Ministry.

Second Early Varieties:—

Ben Lomond.

Tubers - pebble; skin white; eyes shallow; flesh white tinged lemon; sprout purple.

Haulm - bushy, upright; internodes short, weak, bronzed, knife-edged; leaflets medium size, medium green, slight bronzing in axil, drooping, corrugated.

Flowers - white.

International Kidney.

Tubers - long kidney, flat; skin white; eyes shallow; flesh white; sprout mauve.

Haulm - upright, medium; stems not branched; internodes medium, weak, mottled purple; leaflets medium to small, rolled, folded, dark green, shiny, terminal leaflets frequently fused.

Flowers - none observed, buds dropping.

Marquis of Bute.

Tubers - round; white skin; eyes pink, deep; flesh white; sprout pink.

Haulm - upright, somewhat resembling Nithsdale; leaflets broad and glossy.

Flowers - white, few.

Late or Maincrop Varieties:—

Ben Cruachan.

Tubers - round to pebble; skin white; eyes shallow; flesh pale lemon; sprout purple.

Haulm - regular, tall, upright; internodes short, bronzed, knife-edged; leaflets corrugated, dull, small, narrow, yellowish-green.

Flowers - white, few, buds dropping.

Ben Ledi.

Tubers - round, flat; skin white; eyes medium; flesh white; sprout rose.

Haulm - regular, upright, erect; internodes short, stout, bronzing in axil; habit of growth somewhat resembling Templar; leaflets medium green, leathery appearance, upright, pointed; leaf closed.

Flowers - white.

Clifden Seedling.

Tubers - round; skin white; eyes medium; flesh white tinged lemon; sprout rose.

Haulm - regular, upright; internodes short, stout, much goffered, slightly bronzed; leaflets medium size, slightly corrugated, upright, dark green.

Flowers - white, large, numerous.

Golden Las.

Tubers - oval, flat; skin white; eyes shallow; flesh yellow; sprout apparently colourless.

Haulm - erect, bushy; stems light green; internodes thin, short; leaflets dull greyish-green.

Flowers - white.

Millar's Beauty.

Tubers - kidney; skin white; eyes shallow; flesh pale lemon; sprout pink.

Haulm - upright; leaflets medium green, medium size, corrugated; leaf open.

Flowers - none observed, buds dropping.

Peerless.

Tubers - round; skin reddish purple; eyes shallow; flesh white; sprout deep purple.

Haulm - regular, upright; much bronzing of stem and mid-rib; leaflets small, corrugated.

Flowers - white, large, numerous.

Utility.

Tubers - round; skin flushed pink; eyes shallow; flesh white; sprout deep rose.

Haulm - regular, vigorous; stem bronzed, serrated; leaflets medium size, currugated, dull daik gieen; leaf open.

Flowers - none observed, buds dropping.

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NOTES ON MANURES FOR MARCH.

SIR JOHN RUSSELL, D.Sc., F.R.S.,
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The Prevalence of Acid Soils.—It is necessary to draw attention to the prevalence of acid soils in the country because no treatment short of liming will enable the farmer to make the best use of them on any ordinary system of farming.

Some time ago the Rothamsted Experimental Station invited agriculturists and expert advisers to send in particulars of infertile soils where the infertility did not appear to be due to any ordinary or known cause. In practically all instances so far referred to us investigation has shown that the trouble is due to acidity, which in some cases has become very pronounced. The symptoms are not always clearly recognised, but there are certain well defined characteristics which every farmer should know and be able to observe without difficulty.

In the first case the crop on acid soils is almost invariably patchy; there are streaks of badness or patchiness where the crop is poor or fails altogether, and no amount of manuring helps matters. In some seasons the harmful effects hardly show; in others they are more pronounced.

On grassland the patches are often very dark green in colour, the herbage is not good and there is no clover. Here recognition of the cause is not usually difficult, and most farmers can tell when grassland is suffering from sourness.

With arable crops, however, the case is different; certain of the features are not so generally recognised to be symptoms of sourness. Usually root development is poor, the leaves are yellowish, and from the outset the plants never flourish, although they may not actually die. The appearance is not unlike that of plants on water-logged soil, but the trouble occurs on land which is well-drained and it also appears in dry seasons.

An excellent illustration was afforded on a farm which the writer had occasion to visit last October, where the field was reported to be infertile in places though the remaining part was quite good. The soil is a medium loam on the ironstone sand, and the crop was mangolds. The appearance of the plants on the bad patches suggested direct poisoning; the plants were small and had never grown, although on the surrounding land some immense roots were seen. The leaves were yellowish and had at no time acquired a healthy green colour; they also remained small. The root development was very stunted and gave the impression of root asphyxiation, as if the ground had lain wet; but the farmer was quite clear that the land was not water-logged even in wet weather. It was difficult to say which was the more remarkable phenomenon: the striking contrast between the good and the bad plants, or the fact that such sickly-looking plants could have survived to the end of the season without appreciable growth and apparently neither living nor dying.

The possibility that the bad effects were due to waterlogging was further ruled out by the circumstances that they had been just as marked, and the appearance was much the same, for the wheat crop on the field in the very dry season of 1921 as for mangolds in the wetter season of 1922. Potatoes had also been affected.

Examination of the soil showed the patches to be extremely acid. The method now in use at Rothamsted allows a much better measurement of acidity than was previously possible, and enables us to place soils in their position in a fertility scale. Tested by this method the bad patches were found to be near the limit where sterility is reached, and even the good soil had no great margin of safety. The recommendation given to the farmer was to lay out three strips across the field receiving respectively 2½, 5 and 10 tons of powdered carbonate of lime per acre; after seeing the results for one season it will be possible to decide on the most suitable dressing for the whole field. It would of course be possible to recommend at once a dressing sufficient to remove all acidity, but this might be more than is immediately necessary and no farmer at the present time wishes to spend more on his land than can be helped.

Another instance was brought to our notice almost at the same time. The crop was white turnips and it failed in patches. In this case a clue was given in that spurrey grew abundantly. Examination showed that the soil was acid almost to the limit

of sterility, and the same recommendation was made as in the preceding case.

These two soils both came from the eastern part of England. Our observations in the West Country show that the need for lime is there very great, and farmers' clubs would be well advised to go into the matter and see if there is any possibility of arranging for the work to be done on some co-operative or other basis that would eliminate all unnecessary expenditure.

Nitrogenous Top-Dressings for Cereal Crops: some Results of last Season.—The results of last season's experiments are now coming in, and they afford striking illustrations of the value of nitrogenous dressings for cereal crops. Among those already to hand are the following:—

Herts, Rothamsted—Wheat:

Per acre.	*Grain, bush. per ac.*	*Straw, cwt. per ac.*
1 cwt. sulphate of ammonia	22·5	23·8
No nitrogen	14·2	18·0
	8·3	5·8

Devon—Wheat:

Per acre.	*Grain, bush. per ac.*	*Straw, cwt. per ac.*
1 cwt. sulphate of ammonia and 5 cwt. basic slag	38·9	20·9
No nitrogen, but 5 cwt. basic slag	29·6	13·9
	9·3	7·0

Gains of 8¼ and 9¼ bushels of wheat grain respectively, and 6 and 7 cwt. of straw respectively were obtained from the use of 1 cwt. of sulphate of ammonia. There could be no doubt that nitrate of soda would have acted at least as well.

Cumberland—Oats:

Per acre.	*Grain, bush. per ac.*	*Straw, cwt. per ac.*
1 cwt. sulphate of ammonia	63·75	47·25
No nitrogen	55·5	44·25
	8·25	3·0

Gains of 8¼ bushels of oats and 3 cwt. of straw were obtained from 1 cwt. of sulphate of ammonia: and again it is practically certain that as good a result could be obtained with nitrate of soda.

Instances could be multiplied where top dressings of nitrogenous fertilisers have proved advantageous to cereal crops.

Manurial Dressings for Barley.—A number of experiments were carried out at different centres last year to test a scheme organised by the Rothamsted Experimental Station in conjunction with the Institute of Brewing. The results are being worked

out, but already at a number of centres it is being found that a complete dressing of artificial manures increases the yield and usually improves, but never depresses the quality. Among some of the results already worked out are :—

	Louth, Lincs.	*Walcott, Lincs.*	*Rothamsted.*
Complete artificials	30·9	60·3	32·6
No manure	25·2	56·9	25·8
Gain, bush. of barley ...	5·7	3·4	6·8

The 3.4 bushel gain at Walcott, however, was insufficient to pay for the manure, it being difficult to increase a yield which is already nearly 57 bushels by any profitable means.

Prices of Artificial Manures.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	Price per ton Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	14.10	13.17	13.10	13 15	17. 9
„ „ Lime (N. 13 per cent.)	...	...	...	12. 2	18. 8
Sulphate of Ammonia, ordinary (A. 25¼ per cent.)	15.15*	15.15*	15.15*	15.15*	(N)15. 2
„ „ „ neutral (A. 25¾ per cent.)	16 18*	16.18*	16.18*	16 18	(N)15.11
Kainit (Pot. 12½ per cent.)	...	..	...	1.17	3. 0
French Kainit (Pot. 14 per cent.)	2. 5	2. 1	...	2. 2	3. 0
Sylvinite (Pot. 20 per cent.)	...	...	..	3. 0	3. 0
Potash Salts (Pot 30 per cent.) ...	...	...	..	4. 5	2.10
Muriate of Potash (Pot. 50 per cent.) ...	..	8.15	8.10	8 15	3. 7
Sulphate of Potash (Pot. 48 per cent.) ...	...	12.15‡	12. 0	12 0	5. 0
Basic Slag (T.P. 30-32 per cent.)	3.15§	...	...	3.17§	2. 6
„ „ (T.P. 24-26 per cent.)	.	2.13§	2.12§	...	...
„ „ (T.P. 20-22 per cent)	2.12§	2. 5§	...	2.15§	2. 7
„ „ (T.P. 16-18 per cent.)	2. 2§	..	2. 5§	2.11§	3. 0
Slag Phosphate (T.P. 60 per cent.) ...	6 7§	...	..	6.15§	2. 3
„ „ (T.P. 50 per cent.) ...	...	...	...	5.15§	2. 4
„ „ (T.P. 40 per cent.) ...	4. 7§	...	...	..	...
Superphosphate (S.P. 35 per cent) ...	4. 2	. .	4. 0§	3.15	2. 2
„ (S.P. 30 per cent.) ...	3 12	3. 2	3 10§	3. 7	2 3
Bone Meal (T.P. 45 per cent.)	9.10	9.10†	9. 0	9 0	...
Steamed Bone Flour (T.P. 60 per cent.) ..	8 10†	7.10†	8. 0	7. 0	...
Fish Guano (A. 9-10, T.P. 16-20 per cent.)...	12.15	...	12. 5	12.15	...

Abbreviations: N.=Nitrogen; A.=Ammonia; S P.=Soluble Phosphate; T.P.= Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ At Goole.

§ Prices include cost of carriage from works to town named. Cost to purchasers in other districts will be greater or less according to the distance of different purchasers from the works.

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NOTES ON FEEDING STUFFS FOR MARCH.

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Ministry of Agriculture and Fisheries.

The Effect of Feeding Stuffs on the Quality of Bacon.—In the feeding of pigs for bacon production, there are several factors to be taken into account if it is desired to produce bacon of good quality. According to the extensive studies of Danish and Canadian investigators, it would appear that the production of poor quality bacon is due to the following factors, namely, improper feeding, unthriftiness, lack of exercise, immaturity and lack of finish.

The three chief fats present in the pig are olein, palmitin and stearin. Olein is liquid at ordinary temperatures, while the other two are solid. Shutt, of the Ottawa Experimental Station, came to the conclusion that soft, oily bacon is caused by the presence of too large a proportion of olein in the fat. It has also been shown that pigs finished under stye conditions in a warm atmosphere produce a much firmer bacon than those fed under cold, draughty conditions.

The chief contributory cause to the production of soft, oily bacon of low quality is, however, the use of unsuitable feeding stuffs and unsuitable mixtures of feeding stuffs. As a general rule, feeding stuffs rich in oil give a bacon of poor quality, while feeding stuffs rich in carbohydrates and poor in oil give a good quality bacon. It is stated that linseed cake, rich in oil gives a soft, oily carcass, whereas linseed meal from which the oil has been extracted, gives a good carcass with white, solid fat.

It becomes very important, therefore, for all pig feeders producing pigs for bacon, to study carefully the mixture given to their pigs, particularly in the later stages of fattening. Unless a dry-feeding system is adopted the amount of water in the slop given should be gradually reduced, and in the last month of fattening the slop should be of the consistency of thick porridge. Maize meal is notoriously unsuitable for bacon, and should not form a very large proportion of the meals used in the finishing period. A pig finished largely on maize meal gives an oily, yellow carcass, and most oil cakes and oil meals, particularly earthnut meal and soy bean meal, give a soft, oily

DESCRIPTION.	Price per Qr. s.	lb.	Price per Cwt. s.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv. s.	Price per lb. Starch Equiv. d
Wheat, British	43/-	504	9/7	9 12	0 18	8 14	71·6	2/5	1·29
Barley, British Feeding	28/9	400	8/1	8 2	0 14	7 8	71	2/1	1·12
" Danubian "	31/6	400	8/10	8 17	0 14	8 3	71	2/4	1·25
" Persian "	28/9	400	8/1	8 2	0 14	7 8	71	2/1	1·12
Oats, English White	30/-	336	10/-	10 0	0 16	9 4	59·5	3/1	1·65
" , Black & Grey	27/6	336	9/2	9 3	0 16	8 7	59·5	2/10	1·52
" Scotch White	36/-	336	12/-	12 0	0 16	11 4	59·5	3/9	2·01
" Canadian No. 2 Western	30/3	320	10/7	10 12	0 16	9 16	59·5	3/4	1·78
" " No. 3 "	28/9	320	10/1	10 2	0 16	9 6	59·5	3/2	1·70
" " Feed	27/9	320	9/9	9 15	0 16	8 19	59·5	3/-	1·61
" American	26/-	320	9/1	9 2	0 16	8 6	59·5	2/9	1·47
" Argentine	26/-	320	9/1	9 2	0 16	8 6	59·5	2/9	1·47
Maize, Argentine	37/6	480	8/9	8 15	0 15	8 0	81	2/-	1·07
" American	37/-	480	8/8	8 13	0 15	7 18	81	1/11	1·03
Beans, English Winter	50/-	532	10/6	10 10	1 17	8 13	67	2/7	1·38
" Rangoon	—	–	8/9	8 15	1 17	6 18	67	2/1	1·12
Peas, English, Dun	60/-	504	13/4	13 7	1 13	11 14	69	3/5	1·83
" " Maple	92/-	504	20/5	20 8	1 13	18 15	69	5/5	2·90
Millers' offals—									
Bran, British	—	—		7 10	1 11	5 19	45	2/8	1·43
" Broad	—	--		8 10	1 11	6 19	45	3/1	1·65
Fine middlings (Imported)	–	—		9 0	1 5	7 15	72	2/2	1·16
Coarse middlings (British)	—	—	—	7 12	1 5	6 7	64	2/-	1·07
Pollards (Imported)	—	—	—	6 17	1 11	5 6	60	1/9	0·94
Barley Meal		—	–	10 5	0 14	9 11	71	2/8	1·43
Maize "	--			10 5	0 15	9 10	81	2/4	1·25
" Germ Meal	—	—	—	9 15	1 2	8 13	85·3	2/0	1·07
" Gluten-feed	—	—		9 5	1 12	7 13	75 6	1/10	0·98
Locust Bean Meal	—	—	—	8 2	0 11	7 11	71·4	2/1	1·12
Bean Meal	—	—	–	12 12	1 17	10 15	67	3/3	1·74
Fish "	–	—	–	15 15	4 19	10 16	53	4/1	2·19
Linseed			—	20 15	1 16	18 19	119	3/2	1·70
" Cake, English (9% oil)	—	—	-	13 17	2 4	11 13	74	3/2	1·70
Soya Bean Cake (6% oil)	—	—		12 5	3 2	9 3	69·1	2/8	1·43
Cottonseed " English (5% oil)	—	—	—	8 0	2 0	6 0	42	2/10	1·52
" " Egyptian (5% oil)	—	—	—	7 17	2 0	5 17	42	2/9	1·47
Coconut Cake (6% oil	—	—	–	9 2	1 15	7 7	73	2/-	1·07
Decorticated Ground-nut Cake (9% oil)	—	—	--	13 5	3 4	10 1	73	1/8	0·89
Palm Kernel Meal (2% ")	—	—	–	6 7	1 8	4 19	71·3	1/4	0·71
Feeding Treacle	—	—	—	4 7	0 9	3 18	51	1/6	0·80
Brewers' grains, dried, ale	—	—	–	7 15	1 8	6 7	49	2/7	1·38
" " " porter	–	—	—	7 5	1 8	5 17	49	2/5	1·29
" " wet, ale	—	—	—	1 7	0 11	0 16	15	1/1	0·58
" " wet, porter	-	—	—	1 2	0 11	0 11	15	-/9	0·40

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of January and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose coconut cake is offered locally at £10 per ton. Its manurial value is £1 15s. per ton. The food value per ton is therefore £8 5s. per ton. Dividing this figure by 73, the starch equivalent of coconut cake as given in the table, the cost per unit of starch equivalent is 2s. 3d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·21d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices:—N. 15s. 2d.; P_2O_5 4s. 7d.; K_2O 2s. 10d.

carcass. Beans are also said to be unsuitable for bacon production, but the available evidence is not very clear on this point. Barley meal, separated milk, whey, pea meal, wheat middlings and crushed oats are all suitable for bacon production and give a good quality carcass. Potatoes and most root crops are suitable foods for pigs intended for bacon. Of the oilcakes, palm kernel and coconut cakes are suitable for inclusion in the finishing period.

Cakes and meals that have been found suitable for the production of mutton and beef are not suitable for producing good quality bacon. The pig naturally tends to produce a soft fat, whereas sheep and bullocks tend to produce a hard fat. Cakes and meals are fed to sheep and bullocks for the purpose of softening the fat, and it is obvious, therefore, that if the same cakes and meals are given to pigs a soft, oily carcass will result. In feeding pigs for bacon, breeders should endeavour to check the suitability of the mixtures fed by obtaining from the factory a report on the quality of the carcass.

FEEDING STUFFS.	Value per Ton on Farm. £ s	Manurial Value per Ton. £ s.	Food Value per Ton. £ s.	Starch Equivalent per 100 lb.	Value per unit S.E. s. d.	Market Value per lb. S.E. d
Wheat	8 1	0 18	7 3	71·6	2/0	1·07
Oats	6 15	0 16	5 19	59·5	2/0	1·07
Barley	7 16	0 14	7 2	71·0	2/0	1·07
Potatoes	2 0	0 4	1 16	18·0	2/0	1·07
Swedes	0 17	0 3	0 14	7·0	2/0	1·07
Mangolds	0 15	0 3	0 12	6·0	2/0	1·07
Good Meadow Hay	4 16	0 16	4 0	31·0	2/7	1·38
Good Oat Straw	2 12	0 8	2 4	17·0	2/7	1·38
Good Clover Hay	5 6	1 3	4 3	32·0	2/7	1·38
Vetch and Oat Silage	2 0	0 8	1 12	14·0	2/3	1·22

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Adulteration of "Sussex Ground Oats."

A CASE of considerable interest to poultry keepers was recently heard at Nottingham. In this instance, the Local Authority of Nottingham proceeded under the Merchandise Marks Act, 1887, on behalf of the Ministry of Agriculture, against a firm who had applied the description "Sussex Ground Oats" to an article which consisted of a mixture of 80 per cent. of ground oats and 20 per cent of barley. The idea has been current for many years that the addition of barley was necessary to facilitate the grinding of

oats to the degree of fineness required in the case of Sussex ground oats, and it has even been alleged that any purchaser of Sussex ground oats would expect to get a proportion of barley in the oats. The Ministry, however, called in evidence some of the principal millers of Sussex ground oats, who proved that the addition of barley is not necessary and that the practice is not adopted by firms of repute. This was confirmed by the evidence of the Government Analyst, who stated that a considerable proportion of a number of samples of ground oats submitted to him were commercially pure. A point raised by the defence was that at the time the sample in question was manufactured, barley and oats were about the same in price, but the evidence for the prosecution showed that barley costs £1 per ton less to grind than oats, so that even when barley and oats are the same price, there is still an inducement to add barley meals. It was, moreover, pointed out that low grade barley, which makes a good meal, can often be bought at a very low price.

A fine of £10 and £15 costs was imposed. It is hoped that the result of these proceedings will tend to check the adulteration of Sussex ground oats, which has been unfortunately common for many years past. Poultry keepers who desire to use a mixture of ground oats and barley should purchase the articles separately and mix them for themselves.

* * * * * *

College Course in Milk Recording.

ARRANGEMENTS have been made with the authorities of the Midland Agricultural College, to hold a course of instruction in Milk Recording, from 30th April to 19th May, 1923, provided that a sufficient number of students apply for admission. A syllabus showing full particulars of the course may be obtained on application to the Principal, Midland Agricultural College, Sutton Bonington, Loughborough. The course includes lectures on milk—its nature and composition—bacteria and their relation to milk, testing of milk, and the principles and practice of milk recording; and practical work on actual milk recording of a comprehensive character, including food records, cost of foods, and cost of food per gallon of milk. The tuition fee will be £3. Board may be obtained at the Sutton Bonington Hostel (30s. per week), or at the Kingston Hostel (27s. per week).

Preference will be given to students who are either already milk recorders under the Ministry's scheme or who intend to apply for such posts. It is not possible to give any indication as to what vacancies for milk recorders may arise, nor can any guarantee be given that students will in fact obtain employment as milk recorders. The names of successful students will, however, be circulated by the Ministry to all milk recording societies in order that preference may be given by societies to these students on the occasion of filling a vacancy. The appointments carry salaries ranging usually from £150 to £250 per annum, and they afford to young agriculturists a unique opportunity of acquiring a practical knowledge of dairy farming, often of the best type, as carried out on a variety of farms.

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The National Utility Poultry Society's Egg-Laying Test, 1921-22.

FROM 1st November, 1921, to 4th September, 1922, the National Utility Poultry Society, in conjunction with the Great Eastern Railway Co., carried out the fifth of its series of egg-laying tests on the Company's farm at Bentley, Suffolk. This was the second test in which the co-operation of the Utility Duck Club was secured in promoting a section for the testing of ducks. The number of pens entered was 368, consisting of 1,540 pullets and 265 ducks, a record for trials in this country.

The number of Sections was increased to nine, viz. :—(1) White Leghorns, (2) White Wyandottes, (3) Rhode Island Reds, (4) Sussex (any variety), (5) Sitting breeds (other than the above), (6) Non-sitting breeds (other than White Leghorns), (7) G. E. Railway employees, (8) Championship, (9) Members of the N.U.P.S., and (10) Ducks. In the case of fowls, eggs were classified as first grade during the first four weeks which weighed 1$\frac{7}{8}$ oz. or more, during the second four weeks 1$\frac{15}{16}$ oz. or more, and during the rest of the trial 2 oz. or more. Eggs of less than those weights but not less than 1$\frac{5}{8}$ oz. were classed as second grade, and not more than 100 second grade eggs in Sections 1 to 6, 200 in Section 7, 80 in Section 8, and 40 in Section 9 were included in the pen score for competitive purposes. No eggs weighing less than 1$\frac{5}{8}$ oz. were scored. As regards ducks, only eggs weighing 2 oz. or more scored.

The following table shows the total number of eggs laid by each breed during the 44 weeks:—

FOWLS.

Died during Test	No. of Birds entered	Breed	Eggs Laid Grades 1st	2nd	Total	Average per bird for 44 weeks
32	640	White Leghorns ...	94,026	8,192	102,218	162·69
12	373	White Wyandottes ..	50,069	8,717	58,786	159·86
3	203	Rhode Island Reds ..	27,934	2,411	30,345	150·43
3	103	Light Sussex	12,689	896	13,585	133·64
—	25	Speckled Sussex	2,883	445	3,328	133·40
—	5	Barred Rocks	627	6	633	126·60
1	9	Buff Rocks	979	25	1,004	114·76
-	5	Croad Langshans	638	21	659	131·80
	5	Golden Barred Ply. Rocks	662	21	683	138·00
—	10	White Orpingtons	1,134	47	1,181	118·10
1	10	Buff Orpingtons	1,110	147	1,257	132·79
—	5	Columbian Wyandottes ..	654	74	728	145·60
5	60	Anconas	8,392	195	8,587	147·95
-	10	Brown Leghorns	1,254	41	1,295	129·50
4	65	Black Leghorns	8,694	750	9,444	152·59
1	10	White La Bresse	1,320	147	1,167	156·93
—	2	Golden Campines ...	128	—	128	64·00
62	1,540	TOTAL	213,193	22,135	235,328	—
		Eggs under weight .		—	346	
		Unrecorded eggs ...	—	—	1,602	
					237,276	

DUCKS.

Died during Test	No. of Birds	Breed	Eggs laid 1st Grade	Under Weight	Total	Average per bird for Test
1	30	Buff Orpingtons	4,842	14	4,858	161·93
	5	Coaley Fawns	1,094	12	1,106	221·20
1	75	Khaki Campbells	13,980	76	14,056	188·45
3	80	Indian Runners (Fawn and White)	13,887	25	13,912	175·12
—	70	Indian Runners (White) ..	11,591	10	11,601	165·72
—	5	Magpies	770	1	771	154·20
5	265	TOTAL	46,164	140	46,304	175·91
		Eggs unrecorded . . .	—	—	140	
					46,444	

The number of eggs per bird produced by the five leading pens in each of the Sections was as follows :—

1	White Leghorns	204, 199, 198, 193, 193.
2	White Wyandottes ...	202, 196, 195, 189, 189.
3	Rhode Island Reds ...	182, 176, 175, 175, 174.
4	Sussex	170, 167, 164, 159, 153.
5	Other Sitting Breeds ...	146, 137, 135, — —
6	Other Non-sitting Breeds	192, 180, 176, 175, 163.

7 Championship (All White 'Leghorns, 10 in pen)	190, 188, 187, 178, 175.
8 G.E. Ry. Employees (4 pullets)	186, 178, 178, 162, 156.
9 Members N. U. P. S. (2 pullets)	204, 199, 197, 194, 191.
10 Ducks (5 in pen) :—	
1 Khaki Campbells	233.
2 do.	227.
3 Coaley Fawns	219.
4 Khaki Campbells	217.
5 Fawn and White Runners ...	209.

It is mentioned in the report of the trial that throughout the test the health record of both pullets and ducks was excellent. The comparative immunity from infectious diseases is attributed to the exclusion of any pens containing unfit birds, even if they were suffering only from contagious catarrh, which, even if not serious in itself, offers a seed bed for roup.

* * * * * *

Importation of Plants, Bulbs, etc., into New Zealand.

NURSERYMEN and others interested in the export of plants, bulbs, etc., to New Zealand should note that, under amended regulations issued by the Dominion Government, all consignments imported into the Dominion from this country must be accompanied by a certificate issued by an Inspector of the Ministry. Certificates issued by the Director of any public or botanic garden in this country will not in future be accepted. Applications for the necessary certificates should be addressed to the Secretary, Ministry of Agriculture, at 10, Whitehall Place, London, S.W.1.

* * * * * *

Importation of Plants, Bulbs, etc., into the U.S.A.

PERSONS concerned in the trade in plants, bulbs, etc., to the United States of America, may be interested in the developments which have taken place since the Conference on the U.S.A. Plant Import Regulations (Quarantine No. 37) was held in May last, when British interests were represented by Mr. W. G. Lobjoit, Controller of Horticulture of the Ministry.

Three small modifications in the regulations have since been made. These extend the period during which Rhododendrons

may be imported under permit, restrict the sizes of rose stocks admitted, and modify the requirement as to removal of soil from the roots of plants so as to allow the use of other means beside washing.

In addition the U.S. Department of Agriculture has now authorised for a period not exceeding three years from 1st January, 1923, the addition to this list of the following varieties of bulbs :—

Chionodoxa (glory-of-the-snow).
Galanthus (snowdrop).
Scilla (squill).
Fritillaria imperialis (crown imperial).
Fritillaria meleagris (guineahen-flower).
Muscari (grape hyacinth).
Ixia.
Eranthis (winter aconite).

It is also announced that the entry of Narcissus is limited to a period of three years only from 1st January last.

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Farm Wages in Scotland.*

As was anticipated, the recent Martinmas hirings were the occasion of further reductions in the wages of a number of farm workers in Scotland.

Married Ploughmen.—In the greater part of Scotland married ploughmen are usually engaged for a year from Whitsunday, and consequently were not affected by Martinmas hirings. New bargains are made at Martinmas, however, with married ploughmen in the industrial areas stretching from Dundee to Ayr, and from the following table of the estimated wages at different periods it will be seen that considerable reductions have been made in these areas :—

AREA.	CASH WAGES.			
	1907.	Summer 1921.	Winter 1921–22.	Winter 1922–23.
Lower Clyde Valley and North Ayr...	17/-	58/-	49/-	37/-
Stirling and West Fife... ...	17/-	57/-	48/-	38/-
East Fife, South Forfar and Perth Lowlands	15/-	45/-	34/-	27/-

It should be remembered that the cash wage does not include the value of allowances in kind, which now ranges from 8s.

* From particulars given in a communication received from Sir James Wilson, K.C.S.I.

per week in Stirling and West Fife to 11s. in East Fife and district.

The average cash wage of married ploughmen for the whole of the areas of Scotland for which statistics are available is now 31s. per week, with allowances valued at 7s. 2d., thus making the total earnings 38s. 2d. per week. If account is taken, however, of the large number of ploughmen in the counties in which earnings are higher, and of the reports that the men who stayed on in their old places obtained higher rates than those who changed employment, the present average earnings of this class of worker come to about 40s. per week, or 82 per cent. above the 1914 level.

This compares favourably with the latest cost of living index figure of the Ministry of Labour, and shows that the standard of living of the married ploughman is at least being maintained at the pre-war level.

Single Ploughmen.—In the majority of areas single ploughmen engage for a half-year from Whitsunday, and so have to make new bargains at Martinmas. Average reductions in wages of about 4s per week were made at Martinmas, in spite of which a considerable number of men remained unengaged.

Women Workers.—In most cases there was a slight fall in the wages offered to women, although there is some difficulty in getting a sufficient supply of this class of worker.

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A Birmingham Clean Milk Scheme.

SOME interesting particulars are now available concerning a "Clean Milk" Scheme which was operated in Birmingham last year by the Midland Counties Dairy Company. Under this Company's scheme bacterial counts were taken every day from a sample of the milk sent in by each of the supplying farmers. A bonus was then paid at the end of every month to the 36 farmers whose milk during the month was found to contain the lowest number of bacilli per cubic centimetre. Of these 36 farmers, the 12 whose score was the lowest received one penny per gallon extra for all their milk, and the next 24 a half-penny per gallon extra. In this way some of the farmers who competed received from £50 to £60 each more for their milk than they otherwise would have received. The following were the best six and the worst six scores (in bacteria per cubic centimetre) during the months mentioned:—

LOWEST SCORES (*cleanest milk*).

	May (1922)	August	December
1	9,000	3,400	6,650
2	12,000	9,900	7,500
3	14,000	12,000	8,500
4	18,000	12,750	10,900
5	22,200	14,250	12,900
6	32,000	16,000	13,500

(The farms which took the first, second, third, etc., place in May were not necessarily the same farms which took those places in August and December.)

HIGHEST SCORES (*dirtiest milk*).

1	10,744,666	8,070,000	648,800
2	12,000,000	10,488,500	750,000
3	16,042,000	11,640,000	859,500
4	Uncountable*	12,010,000	1,377,000
5	Uncountable*	15,035,500	1,950,000
6	Approx. 30,000,000	19,580,000	Over 50,000,000

* In 1/10,000 dilution.

Some 80 to 90 farmers in all competed under this scheme, and it is understood that the average bacterial count of about half of them was lower than 20,000 per c.c.

The results of this admirable scheme must give satisfaction to all who wish to see a higher standard of cleanliness in the milk supply, and it is to be hoped that the example set by the Midland Counties Dairy Company will be followed by other large milk distributing companies throughout the country.

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Temporary Restriction of Hop Production.

THE Ministry desires to call the attention of hop growers to the advisability of taking immediate steps to limit their production of hops during the current year. The consumption of beer in the United Kingdom has been reduced to approximately one-half of its pre-war level. There are now about 27,000 acres under hops as compared with 36,000 acres before the War. In consequence, if an average crop is produced on the existing acreage there will be a considerable surplus of English hops over and above the amount brewers will require should consumption not increase. Further, it is estimated that a surplus of about 100,000 cwt. of the 1922 crop of English hops will be left in growers' hands after the Hop Controller has completed his purchases to meet brewers' requirements for the current season. In these circumstances, the Hop Controller does not expect to be able to purchase from

each grower a greater quantity of the 1923 crop than is approximately equivalent to three-quarters of the amount arrived at by multiplying the average yield per acre obtained by that grower in 1920, 1921, and 1922, and the acreage which that grower cropped with hops in 1922. A formal intimation of the amount of 1923 hops which the Hop Controller is prepared to purchase from him will be sent to each grower, but as the issue of these notices may take some time the Ministry considers it advisable to warn growers in order that they may at once begin to take steps to restrict the production from their acreage to this lower amount in order that they may have no surplus left on their hands when the Hop Controller has taken the amount of which he can dispose.

It is a penal offence for any person to buy or sell or agree or offer to buy or sell any hops without a permit issued under the authority of the Hop Controller who is authorised to act on behalf of the Minister in this matter, and the Hop Controller will not be prepared to buy, or issue permits for the sale for consumption in Great Britain or Ireland of hops produced in excess of the quantity specified to each grower in the formal notice referred to.

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REPLIES TO CORRESPONDENTS.

"Hubam" Clover.—W.S. asks whether "Hubam" clover and sweet clover refer to the same plant. He understands that sweet clover has great possibilities as a forage crop, and that it is valuable to bee keepers as a honey yielding plant if allowed to grow to the flowering stage.

Reply: Sweet clover is a general term referring to no fewer than 4 distinct varieties of Melilotus. There is a yellow biennial variety, a yellow annual variety, a white biennial variety and a white annual variety. "Hubam" clover is the white annual variety, developed by Professor H. D. Hughes of the Iowa Experiment Station, from selected seed obtained from Alabama.

In America, the biennial variety is seeded in spring on autumn sown rye or wheat, or with barley or oats, at the rate of 12 to 15 lb. of scarified seed per acre. The crop is harvested the following year just before the blossom buds appear.

The annual variety, "Hubam," is sown in early spring and is cut for forage the same year. The seeding is made on bean-land, potato-land or on fallowed land in clean, firm condition. In America, seeding in early spring gives a forage crop in mid July.

Black Spot on Roses.—Miss . . . would be glad of information with regard to Black Spot on rose bushes.

Reply: This disease is caused by a fungus, *Actinonema rosae*. In some varieties of rose this fungus winters on the young twigs which, when infected, should be cut out.

Dusting with 1 part powdered arsenate of lead and 9 parts finely ground sulphur in May and at fortnightly intervals afterwards, has been found very effective, but of course this is a very poisonous preparation and not advisable in a garden if children or animals may have access. Spraying with lime-sulphur at half the strength of that used for Apple Mildew (see details in Leaflet No. 204) has been also found useful, though this renders the bush unsightly.

Diseased Strawberries.—A.Z. sends a strawberry plant "smothered by queer growth."

Reply: The strawberry plant has suffered from the smothering effects of one of the Myxomycetes, *Spumaria alba*. This is a very lowly form of fungus, —indeed it is doubtful if it should be so classified. It increases in size and climbs slowly over plants, especially up the stems of living grasses, and forms, first, white masses, followed later by the soot-like masses of dark spores.

It is not a parasite, but may act harmfully in smothering the plant. It is more common in England on grasses, but has been noted in France on strawberries. The spores may have been introduced in one of many ways, but probably with the manure. It is not very common, and if the bed is well dug and the affected plants thoroughly cleared away and burnt it will probably not occur again.

White Clover.—Q.R. requests the necessary information for detecting Wild White Clover from the ordinary White Dutch Clover.

Reply: It is difficult to distinguish the two. If White Clover appears in response to basic slag, it may of course be supposed to be wild white. Otherwise the two varieties cannot be distinguished botanically, though the wild variety differs somewhat in habit from the cultivated. These differences are set forth in a pamphlet on the "Romance of Wild White Clover" obtainable from Messrs. Gartons of Warrington. Leaflet No. 355 states that the seed of wild white is on the average slightly smaller and that the wild variety is more persistent.

Getting Rid of Tree Stumps.—S.T. asks whether stumps can be burnt by boring with an auger and putting chemicals in.

Reply: Referred to Ministry's Report on Stump Clearing Devices and informed that processes of chemical disintegration were shown by the Ministry's investigations to be futile.

Starch Equivalent of Feeding Stuffs.—U.V. asks for an explanation of the term "starch equivalent."

Reply: By the "Starch equivalent" of a feeding stuff is meant the number of pounds of starch which is equivalent, for the production of energy, to 100 pounds of that feeding stuff.

In the Ministry's Miscellaneous Publication No. 32 this is worked out in two ways as "gross digestible energy" and as "net digestible energy," the latter being usually taken as giving the best figures for the productive value of feeding stuffs.

The "net digestible energy" of wheat, for instance, is 71·6; in other words, if you feed 100 lb. of wheat it is equivalent, for productive purposes, to feeding

Take wheat for instance at £9 15s. per ton. For every ton of wheat fed 18s. comes back in the form of manure. Therefore in feeding a ton of wheat, the feeding costs £8 17s. That is, you pay £8 17s. for a ton of wheat, which for practical purposes may be regarded as containing 71·6 per cent. of starch. What therefore do you pay for 1 per cent. of starch? This you ascertain by dividing the price £8 17s. by 71·6—which gives approximately 2s. 6d. The use of figures thus obtained is a convenient way of comparing the value of feeding stuffs.

Pig Farming.—W.X. asks for figures of capital required.

Reply: It is practically impossible to give even an approximate estimate which would cover all holdings of various sizes and with varying accommodation. The following figures and notes might assist in preparing a rough estimate:—

Capital.

Land (if purchased) say £25 per acre.

Buildings. Good shelters for running on outdoor system at rate of £5 per sow.

Stock. £10 per acre (1 Breeding Sow per acre).

Fencing and Feeding Utensils. £1 to £2 per acre.

Expenditure.

Rent and Rates. 30/- per acre.

Labour. 1 man to every 150 pigs.

Foods. Average cost per head per week, 2/6.

Income.

Each sow should produce 10 pigs per year which at 4–5 months would average 100 lb. dead weight, worth approximately 1/- per lb.

General.

It should be possible to purchase and start a small-holding of 10 acres with £500 and expect a return of 23–30 per cent.—no charge being made for labour.

Crab-apple Trees.—T.R. asks whether the presence of old crab-apple trees in the hedge of an orchard is detrimental to young apple trees, through pollination or in any other way.

Reply: Crab-apple trees growing wild usually produce abundant pollen which should facilitate fertilisation of blossoms of cultivated trees in the vicinity. If the wild trees harbour insect or fungus pests, then they become a source of infection and should be destroyed.

Parsnip Canker.—A Chichester correspondent writes: I shall be glad if you will let me have a copy of any leaflet published on Parsnip Canker, or give me what information is available on this disease.

Reply: In reply to your enquiry of the 16th inst., the Ministry has not published a leaflet dealing with Parsnip Canker, but the trouble is described in some detail by Mr. A. D. Cotton in the Kew Bulletin, 1918, p. 8, and is shown to be "due primarily to a physiological phenomenon which causes the surface tissues to become ruptured, and not to the invasion of a fungus parasite. Cracking takes place during the growing season, especially if rains follow a dry period, and the cracks gape open exposing the soft inner tissues. The canker or decay which follows is the result of the inability of the parsnip to form a layer of wound cork. Though canker is worse in some localities than others it appears to occur in all districts if rupturing of the skin takes place.

Over-manuring, neglect of liming, early sowing (inducing premature ripening) may favour the formation of cracks. The variety of parsnip grown may also be partly responsible, a form of high quality, with bulky top, abundant flesh and small core being very largely cultivated in the worst reas."

With regard to preventive measures the grower is advised to avoid too rich a soil and to adopt late sowing. Liming must not be neglected and a proper rotation should be given—parsnips must never be grown for two years in succession on the same land. The writer also mentions a dressing of salt as having been found effective in some cases—on heavy soils 5 cwt. per acre, on light soils up to 10 cwt. per acre. The use of potash manures is also suggested.

White Fly in Greenhouses.—R.L. asks have you a leaflet or can you advise me the best way of getting rid of White Fly in greenhouses?

Reply: With reference to your letter of the 30th January, the only method of dealing with White Fly upon tomatoes is by means of fumigation, but to obtain the best results it is necessary to use a powerful fumigant such as hydrocyanic acid gas. A leaflet dealing with this treatment is enclosed.

If the highly poisonous nature of hydrocyanic acid gas should be a disadvantage under the circumstances in which you have to use it, you might try tetrachlorethane, and a memorandum on this fumigant is therefore also enclosed. If you have a difficulty in obtaining tetrachlorethane, you will see advertisements in most fruit-growing or gardening papers for proprietary fumigants for use against White Fly on tomatoes which have much the same effect.

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Leaflets issued by the Ministry.—Since the date of the list given on page 671 of the October issue of the *Journal*, the following leaflets have been revised.

Revised.

No. 32.—Foul Brood.
" 111.—Co-operative selling of Eggs.
" 169.—The Cultivation of Mangolds.
" 197.—Agricultural Education in England and Wales.
" 333.—Fish Meal as a Food for Live Stock.
" 358.—Fruit and Vegetable Drying.
" A 316/1.—Abridged List of Publications.

The following new leaflets have been issued.

No. 395.—Diseases of Adult Bees.
" 396.—Feeding Home-grown Corn and Potatoes to Live Stock.

The following leaflets are no longer issued free:—

No. 374.—Hints on Egg Production.
No. 375.— " " The Production of Table Poultry.
No. 376.— " " Rabbit Keeping.

Foot-and-Mouth Disease.—A further outbreak of foot-and-mouth disease occurred at Handley, Cheshire, on 30th January, which involved the slaughter of two cows, the only animals on the premises. As a result of this outbreak restrictions were again applied to an area around Handley, but the circumstances of the outbreak permitted an early reduction of the prohibited area in view of the fact that it had recently been subject to restrictions, and no movements had taken place involving a risk of the spread of the disease.

All restrictions in the Glamorgan district were removed as from 8th February. The outbreak in this county having been successfully confined to the originally infected premises.

On 10th February disease was confirmed on premises at Northleach, Glos., 3 heifers of a lot of 4 being found affected. There had been recent movements to local markets, but there has been no extension of disease except to premises in the proximity of the original outbreak—on which the existence of disease was confirmed on 12th inst. The usual restrictions were imposed on 10th February.

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NOTICES OF BOOKS.

The Evolution of Climate.—(C. E. P. Brookes, M.Sc. (173 pp.) London: Benn Bros., Ltd., 1922. 8/6 net.) It is remarked in the introduction to this book that meteorologists are still so much occupied with the present vagaries of the weather that few of them have the time to extend their researches into the geological past, though therein may be the key to the solution of many problems which they have hitherto faced in vain. Mr. Brooks has applied his knowledge of geology and meteorology to reconstruct the sequence of climatic change through which the world has passed during that important stage of geological history commonly known as the ice age or glacial period. The historical record is preceded by a chapter dealing generally with factors of climate and the causes of climatic fluctuations, and the book concludes with a brief review of the influence of those fluctuations on the evolution of man and the history of civilization.

Pests.—(Palmer and Westell (412 pp.) London : Henry J. Drane, 1922. 5s.) In this book the authors have attempted to give a concise but comprehensive summary of all the important pests, both animal and vegetable, affecting the products of the farmer, forester, fruit-grower and gardener—a "pest" for the purpose of the book being defined as any animal, plant or vegetable organism which is injurious to any kind of crop, produce, or cultivated plant, whether directly or indirectly, and any insect attacking domesticated animals or annoying man himself. The authors have wisely recognised that the practical man has seldom the time or inclination to read intricate scientific details of the natural history of the pests which trouble him, and they have, therefore, concentrated attention on the necessary information at present available to enable him to identify and as far as possible to control or prevent their ravages. A work of this nature necessarily consists largely of compilation, but the references to authorities to whom the authors acknowledge their indebtedness show that the standard works on the various subjects have been drawn upon, and the book presents, in a convenient form, up-to-date information for which otherwise a number of technical and expensive publications would have to be consulted.

The volume, which is of "royal octavo" (10 in. by $6\frac{1}{4}$ in.) size and is handsomely bound in green cloth, is copiously indexed and illustrated, and contains a useful glossary of scientific terms used, besides identification and spraying tables and a monthly calendar of anti-pest operations.

English Local Government — Statutory Authorities for Special Purposes.—(Sidney and Beatrice Webb. (521 pp.). London :

Longmans, Green & Co., 1922. 25s. net). This book constitutes the fourth and final volume of Mr. and Mrs. Sidney Webb's survey of the constitutional structure of English local government from the Revolution (1689) to the passing of the Municipal Corporation Act (1835). Like the preceding studies of "The Parish and the County" and "The Manor and the Borough," it represents a monumental amount of research in recondite contemporary sources, tracing the origin, development and function of such hitherto unexplored organisations as the Court of Sewers, Incorporated Guardians of the Poor, Turnpike Trustees and Improvement Commissioners—who, it is pointed out, were the forerunners of most of the municipal administration of the 19th century. The last two chapters, summarising the contents of the complete survey, give an illuminating account of the gradual transformation of the old institutions and their adaptation to the new conditions and conceptions arising from the industrial revolution and the social and economic changes proceeding from it. As was to be expected from the learned historians of trade unionism and industrial democracy the books are an important addition to historical literature, and should be of special interest to all who are engaged in municipal and local administration.

Electricity in Agriculture.—(Arthur H. Allen. (111 pp.). London: Pitman & Sons, 1922. 2s. 6d.). The applications of electricity to agriculture in this country are still largely unexplored and there is obviously room for a book of even such modest scope as this primer—the first of its kind to be published in this country—indicating briefly some of the chief uses of electricity in the various mechanical operations of the farm, the sources of power available and the methods by which it may be distributed. A chapter is devoted to the domestic applications of electricity in indoor lighting, cooking, heating, etc., and another to "electro-culture"—the latest experiments in which were summarized in the December number of this *Journal.*

Practical Fruit Farming.—(R. G. Hatton, M.A., and Walter R. Edgar, F.S.I. (87 pp.). London: John Murray, 1922. 2s.) "The more one looks into the history of fruit culture the more one is forced to the unpleasing conclusion that, at any rate during the last century, but slow progress has been made in the acquisition of scientific knowledge and in the application thereof: we are now, as it were, only scratching on the surface of a rich and partly unexplored field." This is the conclusion arrived at by Mr. Edgar, whose contribution on "The Planting, Cultivation, and General Management of Orchards in Kent" forms the second part of this useful pamphlet on Practical Fruit Farming, issued by the Royal Agricultural Society. In the first part, by Mr. Hatton, whose work as Director of the East Malling Research Station is well known to pomologists, an attemp made to indicate how far the conclusions of the research worker are of immediate application to the practical grower, and how far the observations and consequent methods of the most successful practical growers have borne the test of time. Considerations are discussed for the selection of a holding, preparation and planting, pruning, manuring and treatment of diseases and pests, and an extensive list of references is added to more exhaustive works on different sections of the subject.

Wheat Costings.—(Herbert Grange. (16 pp.) London: P. S. King & Son, 1922. 1s. 6d.) In this 16-page pamphlet, issued with the object of

drawing attention to the present and prospective position of the grower of corn, Mr. Grange gives an analysis of costs of wheat production per acre and per quarter for the years 1914 and 1919–1922 under the six separate headings of rent, rates and insurance; seed; manure; horse labour; manual labour; and repairs and sundries. The figures for the last two years show an approximate net loss of £6 and £4 10s. per acre, respectively. Mr. Grange explains the basis on which his calculations are based and, though his figures will require modification in the light of fluctuating prices and individual experience, the pamphlet may be of assistance to other inquirers interested in the economics of wheat production.

The Maintenance of the Agricultural Labour Supply in England and Wales during the War.—(J. K. Montgomery. (121 pp.) Rome: International Agricultural Institute. 2s. 6d.) In this report Mr. Montgomery, Chief of the Bureau of Economic and Social Intelligence of the International Agricultural Institute, gives a classified summary of the chief measures taken in this country to supply the place of agricultural workers withdrawn from the land for military service during the War and to provide supplementary labour for the increased production which was required to assure the food supply of the country. Most of those measures were noted in this *Journal* from time to time as they arose during the progress of the War, but future reference will be much facilitated by Mr. Montgomery's memorandum, in which he brings together the various arrangements made for the supply of labour by soldiers, prisoners of war and interned civilians, women landworkers, refugees, conscientious objectors and volunteer helpers. The final chapter gives an account of the working of the Agricultural Wages Board, including tables of minimum wages fixed for workers of various ages in different districts down to the abolition of the Board in August, 1921.

The Journal of Pomology and Horticultural Science.—The growing of their crops tests the full capacity of those engaged in the industry of horticulture, and the measure of success attained by each grower serves as a guide to his ability as a cultivator. Some produce the finest crops—others, smaller crops of a lower quality, but all have difficulties of divers kinds to contend with.

The soil has its own special problems, which even at the present time are only partially understood, though our scientific research workers are gaining more knowledge every year. The plant, be it for fruit, flower, or vegetable production, is always giving anxiety to the cultivator. Is it the right kind for his purpose? Has he the best variety in existence? Are his fruit trees grafted on the right stock to suit his purpose? These are questions put to every good commercial grower. Diseases of crops, also, are always troublesome.

If left unprotected, horticultural crops are attacked by diseases and pests, and growers are not always clear as to the best means to adopt to keep plants healthy. All these problems can only be properly dealt with by those having full knowledge of the pest, and this can be acquired by keeping in constant and close touch with the results of work carried out at research stations. There are at least five such stations in this country engaged on horticultural work: the Long Ashton Horticultural Research Station (near Bristol), the

East Malling Horticultural Station, the John Innes Institute (Merton, Surrey), and the Lea Valley Horticultural Experimental Station (Herts.). At these stations scientific workers are investigating problems of many kinds, differing in character from the manuring of the tomato plant to the control of silver leaf disease. All the work is of importance to the commercial grower.

The reports of this research work will be published in the Journal of Pomology and Horticultural Science, which in effect is the official organ of the first three aforesaid research stations. The Journal will be published quarterly, and can be obtained either from the research stations or from the publishers. The annual subscription is 15s., post free.

The first issue of the new series was published in November, 1922, and contains articles on :—

Commercial Raspberries and their Classification (*N. H. Grubb*);
Apple and Plum Case Bearer (*F. V. Theobald*);
Control of the Apple Blossom Weevil (*H. W. Miles*);

together with several shorter notes.

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ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

Allen, A. H. Electricity in Agriculture. (111 pp.) London: Pitman & Sons, 1922, 2s. 6d. [537.]

Brooks, C. E. P.—The Evolution of Climate. (173 pp.) London: Benn Bros., 1922, 8s. 6d. [551.5.]

Haas, P., and *Hill, T. G.*—An Introduction to the Chemistry of Plant Products, Vol. 2:—Metabolic Processes. (140 pp.) London: Longmans, Green & Co., 1922, 7s. 6d. [58.11; 54(02).]

Weaver, J. E., *Jean, F. C.*, and *Christ, J. W.*—Development and Activities of Roots of Crop Plants: A Study in Crop Ecology. (117 pp. and 14 Plates.) [Carnegie Institution of Washington Publication 316.] Washington, 1922, $2. [58.33.]

U.S. Nitrate Division, Ordnance Office War Department and the Fixed Nitrogen Research Laboratory Department of Agriculture.—Report on the Fixation and Utilization of Nitrogen. (353 pp.) Washington, 1922. [663.6; 63.1671.]

Howell, J. Pryse.—The Productivity of Hill Farming. Being the Report of an Inquiry in three Typical Districts. (23 pp. + 7 statistical tables.) Oxford: University Press, 1922, 1s. [63(42); 63.6(42).]

Denmark Statsfrokontrollen.—Statsfrokontrollen, 1871—1896—1921. (160 pp.) Copenhagen, 1922. [63.1951.]

U.S. Department of Agriculture.—Farmers' Bull. 1271:—Farm Lands available for Settlement. (51 pp.) Washington, 1922. [325; 63(73).]

The Association of British Chemical Manufacturers.—Official Directory of Members with Classified List of their Manufactures. (319 pp.) London: Offices of the Association, 1923, 10s. 6d.

Field Crops.

University College of Wales, Aberystwyth.—Bull. No. 4:—Investigation on the Composition of Farm Crops First Report. (11 pp.) Aberystwyth, 1922. [63.3(04).]

Horticulture and Fruitgrowing.

Bennett, F., and *Rohde, E. S.*—A Vegetable Grower's Handbook. (174 pp.) London: P. Lee Warner (Chiswick Press), 1922, 6s. [63.511(02).]

U.S. Department of Agriculture.—Farmers' Bull. 1269:—Celery Growing. (32 pp.) Washington, 1922. [63.511.]

U.S. Department of Agriculture.—Bull. 1082:—The Production of Tulip Bulbs. (48 pp.) Washington, 1922. [63.52.]

Royal Agricultural Society of England.—Practical Fruit Farming, by *R. G. Hatton* and *W. R. Elgar.* (87 pp.) London: John Murray, 1922, 2s. [63.41(04); 63.41(42).]

U.S. Department of Agriculture.—Farmers' Bull. 1284 :—Apple Orchard Renovation. (32 pp.) Washington, 1922. [63.42(04).]

Seabrook, W. P.—Fruit-Packing for Market : a Practical Treatise on the Grading, Packing and Marketing of Hardy Fruit. (90 pp.) London : George Allen & Unwin, Ltd., 1922, 2s. 6d. net. [63.41—198.]

California Agricultural Experiment Station.—Bull. 344 :—Cold Storage as an Aid to the Marketing of Plums : a Progress Report. (pp. 428—463). Berkley, 1922. [63.41—198.]

Plant Pests and Diseases.

Palmer, R., and *Westell, W. P.*—Pests of the Garden and Orchard, Farm and Forest : A Practical Guide for the use of the Estate Owner, Farmer, Fruit Grower and Gardener concerning the Insects, Birds and Other Animals, Fungoid Diseases and Weeds, affecting Agriculture, Horticulture and Forestry; together with Remedial Measures. (412 pp.) London : H. J. Drane, 1922, 25s. [63.24(02); 63.27(02); 63.259(02); 63.26; 63.295; 59.162; 63.296.]

Canada Department of Agriculture.—New Series Bull. 7 (Ent. Bull. 21) :—Insects Affecting Greenhouse Plants. (63 pp.) Ottawa, 1922. [63.27—41; 63.27—51; 63.27—52.]

U.S. Department of Agriculture.—Bull. 1104 :—Internal Browning of Yellow Newtown Apples. (24 pp.) Washington, 1922. [63.21.]

Connecticut Agricultural Experiment Station.—Bull. 235 :—Experiments in Dusting *v.* Spraying Apples and Peaches in Connecticut in 1921. (pp. 209—226.) New Haven, 1922. [63.294.]

Live Stock and Feeding Stuffs.

Gouin, R.—Les Aliments du Bétail et les Intoxications Alimentaires. (356 pp.) [Encyclopédie Agricole.] Paris : J. B. Baillière et Fils, 1922, 15fr. [63.255; 63.60432(02).]

Gouin, R.—Alimentation Rationnelle des Animaux Domestiques. (403 pp.) Fifth Edition. [Encyclopédie Agricole.] Paris : J. B. Baillière et Fils, 1922, 15 fr. [63.6043(02).]

Olympia Agricultural Co., Ltd., Research Department.—Bull. 3 :—Feeding Experiments with Fattening Pigs. (33 pp.) Offchurch, Leamington, 1922. [63.64 : 043.]

U.S. Department of Agriculture.—Farmers' Bull. 1263 :—Breeds of Swine. (22 pp.) Washington, 1922. [63.64(04).]

U.S. Department of Agriculture.—The Live Stock Industry in South America. (35 pp.) Washington, 1922. [63.6(8).]

Massachusetts Agricultural Experiment Station.—Bull. 205 :—Dried Apple Pomace for Farm Stock. (pp. 135—148.) Amherst, 1921. [63.604(*a*).]

Dairying.

U.S. Department of Agriculture.—Bull. 1071 :—Influence of Season of Freshening on Production and Income from Dairy Cows. (10 pp.) Washington, 1922. [63.711(*b*).]

U.S. Department of Agriculture.—Bull. 1095 :—Producers' Co-operative Milk Distributing Plants. (44 pp.) Washington. 1922. [334.6.]

U.S. Department of Agriculture.—Bull. 1097 :—The Effect of Silage on the Flavor and Odor of Milk. (24 pp.) Washington, 1922. [63.711(*a*); 63.719.]

U.S. Department of Agriculture.—Bull. 1101 :—Unit Requirements for Producing Market Milk in Delaware. (16 pp.) Washington, 1922. [63.714.]

Veterinary Science.

Ministry of Agriculture and Fisheries.—Report of the Departmental Committee on Foot-and-Mouth Disease. (78 pp.) London : H.M. Stationery Office, 1922. [Cmd. 1784.] 2s. net. [619.2(*d*).]

Development Commission.—Report of the Advisory Committee on Research into Diseases of Animals. (19 pp.) London : H.M. Stationery Office, 1922, 1s. 6d. [37; 619.]

Marshall, F. H. A.—The Physiology of Reproduction. [2nd and Revised Edition.] (770 pp.) London : Longmans, Green & Co., 1922, 36s. net. [612.]

Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE,
By Metchim & Son, Princes Street, Westminster, S.W. 1.

INDEX TO VOL. XXIX.

April, 1922, to March, 1923.

NOTE.—References to Insects, &c., and Fungi are indexed under the headings "Insects," &c.," and "Fungi" only, to Weeds under the heading "Weeds" only, and to Diseases of Animals under "Diseases of Animals" only.

Articles or reports on the following subjects have appeared in the *Journal* each month or from time to time, and are not separately indexed :—Lists of Additions to the Ministry's Library, and Selected Contents of Periodicals.

Editorial Notes are indexed under the subjects to which they refer.

To avoid confusion in reference the term "Ministry" is used throughout, with a very few necessary exceptions, although the word "Board" may appear in the text.

Date of issue.	Date of issue.	Date of issue.
3.12.41		
7.1.42		
28.2.42		
4.2.46		
2.12.47		